



## Higher Design and Manufacture

<b>Course code:</b>	C819 76
<b>Course assessment code:</b>	X819 76
<b>SCQF:</b>	level 6 (24 SCQF credit points)
<b>Valid from:</b>	session 2018–19

This document provides detailed information about the course and course assessment to ensure consistent and transparent assessment year on year. It describes the structure of the course and the course assessment in terms of the skills, knowledge and understanding that are assessed.

This document is for teachers and lecturers and contains all the mandatory information you need to deliver the course.

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# Course overview

The course consists of 24 SCQF credit points which includes time for preparation for course assessment. The notional length of time for candidates to complete the course is 160 hours.

The course assessment has two components.

Component	Marks	Duration
Component 1: question paper	80	2 hours and 15 minutes
Component 2: assignment	90	see 'Course assessment' section

Recommended entry	Progression
<p>Entry to this course is at the discretion of the centre.</p> <p>Candidates should have achieved the National 5 Design and Manufacture course or equivalent qualifications and/or experience prior to starting this course.</p>	<ul style="list-style-type: none"><li>◆ other SQA qualifications in design and manufacture or related areas</li><li>◆ further study, employment and/or training</li></ul>

## Conditions of award

The grade awarded is based on the total marks achieved across all course assessment components.

## Course rationale

National Courses reflect Curriculum for Excellence values, purposes and principles. They offer flexibility, provide time for learning, focus on skills and applying learning, and provide scope for personalisation and choice.

Every course provides opportunities for candidates to develop breadth, challenge and application. The focus and balance of assessment is tailored to each subject area.

This course allows candidates to develop the knowledge and skills they need to appreciate design and manufacturing industries, and to contribute and adapt to the opportunities they offer.

Candidates develop knowledge of design and commercial manufacture together with the creative and practical skills required to design solutions to real problems. Candidates also gain an understanding of the impact of design and commercial manufacture on everyday life and the environment.

The course encourages candidates to take a broad view of design and manufacture. They do this by making decisions and taking responsibility for their own actions, generating and developing ideas, applying knowledge, and justifying decisions. These transferrable skills place candidates in a strong position regardless of the career path they choose.

## Purpose and aims

The main purpose of the course is to allow candidates to develop the skills and knowledge associated with designing and manufacturing.

Candidates study the lifecycle of products from their inception through design, manufacture, and use, including their disposal and/or re-use. It helps candidates to appreciate the impact commercial manufacture has on design and the need for balance and compromise when developing successful commercial products.

Candidates develop:

- ◆ research skills
- ◆ skills in designing products
- ◆ knowledge and understanding of materials and commercial manufacture
- ◆ knowledge and understanding of design factors
- ◆ an understanding of the impact of design and manufacturing technologies on society, the environment and the world of work

## **Who is this course for?**

The course is suitable for candidates attracted by the creative and practical activities required to design and manufacture commercial products. It allows candidates to be innovative and resourceful when exploring and resolving problems. The course provides a foundation for those considering further study or a career in design, manufacturing, engineering, science, marketing, and related disciplines.

The course also offers a complementary practical experience for those studying subjects in the technologies and expressive arts.

# Course content

The course has two areas of study:

## Design

Candidates study the design process from brief to design proposal. This helps them to develop skills in initiating, developing, articulating and communicating design proposals. Candidates explore and refine design proposals using the design/make/test process and by applying knowledge of materials, processes and design factors to reach a viable solution. This helps them to develop an understanding of the iterative nature of the design process. Candidates also develop an understanding of the factors that influence the design, marketing and use of commercial products.

## Manufacture

Candidates study the manufacture of commercial products. They develop knowledge of materials, manufacturing and production processes and strengthen their understanding of how these influence the design of products. This provides candidates with the knowledge and understanding required to develop a viable design proposal for a commercial product and to plan its production.

Integrating the two areas of study is fundamental to delivering the course successfully. It helps candidates to understand the relationship between designing products and manufacturing products and it helps them to see how this connection influences a product's lifecycle. By combining the study of design with the study of manufacturing, candidates also learn to appreciate the impact design and manufacturing technologies have on society, the environment and the world of work.

## Skills, knowledge and understanding

### Skills, knowledge and understanding for the course

The following provides a broad overview of the subject skills, knowledge and understanding developed in the course:

- ◆ researching and evaluating existing product types
- ◆ selecting and using a range of research techniques and evaluating their usefulness
- ◆ selecting and applying a range of idea-generation techniques
- ◆ writing a detailed specification based on research
- ◆ applying a range of creative design skills when refining and resolving product design tasks that cover key design challenges
- ◆ selecting and using graphic techniques to visually represent design solutions, justifying the choice of techniques
- ◆ selecting, using, and evaluating a range of simple modelling and manufacturing techniques to represent design ideas in three dimensions
- ◆ planning the manufacture of a commercial product and analysing its effectiveness

- ◆ selecting and using a range of tools, equipment, software and materials for designing, making and testing models and prototypes
- ◆ evaluating personal design proposals and associated manufacturing practicalities, and applying suggestions for improvement
- ◆ developing broad knowledge and understanding of the impact of a range of design and manufacturing technologies on our environment and society
- ◆ critically evaluating a range of factors that influence the design and manufacture of products
- ◆ developing knowledge and understanding of a broad range of industrial and commercial manufacturing processes and the properties and uses of materials

## Skills, knowledge and understanding for the course assessment

The following provides details of skills, knowledge and understanding sampled in the course assessment:

Assignment		Question paper	
Skill	Candidates demonstrate the ability to:	Knowledge and understanding	Candidates demonstrate knowledge and understanding of:
Carry out research into a given brief	<ul style="list-style-type: none"> <li>◆ analyse a design brief</li> <li>◆ carry out research</li> <li>◆ present research</li> </ul>	Brief	<ul style="list-style-type: none"> <li>◆ the purpose of the design brief in the design process</li> <li>◆ open and closed design briefs</li> </ul>
		Research and evaluation	<ul style="list-style-type: none"> <li>◆ the purpose of research and evaluation                             <ul style="list-style-type: none"> <li>— throughout the design process</li> <li>— of existing products</li> </ul> </li> <li>◆ information gathered through research or evaluation</li> <li>◆ methods of gathering information                             <ul style="list-style-type: none"> <li>— primary and secondary research</li> </ul> </li> <li>◆ the key stages of the following techniques                             <ul style="list-style-type: none"> <li>— comparisons</li> <li>— questionnaires</li> <li>— surveys</li> <li>— tests and test rigs</li> <li>— user trial</li> <li>— user trip</li> </ul> </li> </ul>



Assignment		Question paper	
Skill	Candidates demonstrate the ability to:	Knowledge and understanding	Candidates demonstrate knowledge and understanding of:
Produce a specification	<ul style="list-style-type: none"> <li>◆ incorporate research findings into a design specification</li> </ul>	Specification	<ul style="list-style-type: none"> <li>◆ the purpose of, and information specified in, the following specification types: <ul style="list-style-type: none"> <li>— product design</li> <li>— performance</li> <li>— technical</li> </ul> </li> </ul>
Generate initial ideas	<ul style="list-style-type: none"> <li>◆ generate initial ideas</li> </ul>	Idea-generation techniques	<ul style="list-style-type: none"> <li>◆ the use of idea-generation techniques</li> <li>◆ the key stages/activities of the following idea-generation techniques: <ul style="list-style-type: none"> <li>— analogy</li> <li>— brainstorming</li> <li>— lifestyle/mood board</li> <li>— morphological analysis</li> </ul> </li> </ul>
Demonstrate practical modelling skills	<ul style="list-style-type: none"> <li>◆ demonstrate practical modelling skills</li> </ul>	Modelling in the design process	<ul style="list-style-type: none"> <li>◆ the use of modelling during the design process to: <ul style="list-style-type: none"> <li>— generate and explore</li> <li>— test and refine</li> <li>— communicate</li> </ul> </li> <li>◆ the purpose of, and information gained from: <ul style="list-style-type: none"> <li>— physical models: sketch models, block models, scale models, test rigs and prototypes</li> <li>— computer-generated models and simulations</li> </ul> </li> <li>◆ benefits and drawbacks of rapid prototyping</li> </ul>
Apply modelling techniques	<ul style="list-style-type: none"> <li>◆ use modelling to develop a design proposal</li> </ul>		

Assignment		Question paper	
Skill	Candidates demonstrate the ability to:	Knowledge and understanding	Candidates demonstrate knowledge and understanding of:
Apply graphic techniques	<ul style="list-style-type: none"> <li>◆ use graphics to develop a design proposal</li> </ul>	Graphics in the design process	<ul style="list-style-type: none"> <li>◆ the purpose and appropriate use of graphic techniques when developing, resolving and communicating ideas throughout the design process</li> <li>◆ the advantages of using manual and computer-generated graphics in the design process</li> </ul>
Develop ideas	<ul style="list-style-type: none"> <li>◆ explore ideas</li> <li>◆ refine ideas</li> <li>◆ apply knowledge and understanding of materials, manufacture and assembly processes</li> <li>◆ apply knowledge and understanding of design issues</li> </ul>	Function	<ul style="list-style-type: none"> <li>◆ the influence of function on the design of products</li> <li>◆ primary and secondary functions</li> </ul>
		Performance	<ul style="list-style-type: none"> <li>◆ the influence of performance on the design of products</li> <li>◆ fitness for purpose of products</li> <li>◆ the influence of planned obsolescence on the manufacturer, consumer and the environment</li> <li>◆ maintenance issues associated with products</li> <li>◆ value for money</li> </ul>
		Safety	<ul style="list-style-type: none"> <li>◆ the influence of safety on the design of products</li> <li>◆ how to ensure safety in products</li> </ul>

Assignment		Question paper	
Skill	Candidates demonstrate the ability to:	Knowledge and understanding	Candidates demonstrate knowledge and understanding of:
		Market	<ul style="list-style-type: none"> <li>◆ the influence of the target market on the design and marketing of products</li> <li>◆ technology push</li> <li>◆ market pull</li> <li>◆ economics</li> <li>◆ product lifecycles: introduction, maturity, growth, and decline</li> <li>◆ the influence of fashion, market trends, style</li> <li>◆ marketing techniques to influence sales</li> <li>◆ niche marketing</li> <li>◆ branding</li> </ul>
		Aesthetics	<ul style="list-style-type: none"> <li>◆ the aesthetics of products</li> <li>◆ influences on the aesthetics of products</li> </ul>
		Ergonomics	<ul style="list-style-type: none"> <li>◆ the influence of ergonomics on the design of products</li> <li>◆ anthropometrics</li> <li>◆ psychology</li> <li>◆ physiology</li> </ul>

Assignment		Question paper	
Skill	Candidates demonstrate the ability to:	Knowledge and understanding	Candidates demonstrate knowledge and understanding of:
		Materials used in the commercial manufacture of products	<ul style="list-style-type: none"> <li>◆ properties and appropriate uses of:               <ul style="list-style-type: none"> <li>— thermoplastics: ABS, acrylic, nylon, polypropylene, polystyrene, polythene, polyvinyl chloride</li> <li>— thermosetting plastics: melamine formaldehyde, urea formaldehyde</li> <li>— elastomers</li> <li>— ferrous metals/alloys: cast iron, mild steel, high-speed steel, stainless steel</li> <li>— non-ferrous metals/alloys: aluminium, brass, copper, tin, zinc</li> <li>— hardwoods: ash, beech, mahogany, oak</li> <li>— softwoods: spruce, pine</li> <li>— manufactured boards: plywood, blockboard, chipboard, hardboard, MDF, flexibly veneered boards</li> <li>— composite materials: carbon-fibre plastics, glass-reinforced plastic</li> </ul> </li> <li>◆ the influence materials have on the design and manufacture of products</li> <li>◆ methods used to identify materials in commercially manufactured products</li> <li>◆ developments in new materials and their impact on products</li> </ul>

Assignment		Question paper	
Skill	Candidates demonstrate the ability to:	Knowledge and understanding	Candidates demonstrate knowledge and understanding of:
		Processes used in the commercial manufacture of products	<ul style="list-style-type: none"> <li>◆ appropriate uses and identifying features of: <ul style="list-style-type: none"> <li>— bending</li> <li>— blow moulding</li> <li>— compression moulding</li> <li>— die casting</li> <li>— drop forging</li> <li>— extrusion</li> <li>— injection moulding</li> <li>— piercing and blanking</li> <li>— press forming</li> <li>— rotational moulding</li> <li>— sand casting</li> <li>— vacuum forming</li> <li>— 3D printing</li> <li>— laser cutting</li> </ul> </li> <li>◆ appropriate uses and identifying features of: <ul style="list-style-type: none"> <li>— chrome plating</li> <li>— galvanising</li> <li>— plastic dip coating</li> </ul> </li> </ul>

Assignment		Question paper	
Skill	Candidates demonstrate the ability to:	Knowledge and understanding	Candidates demonstrate knowledge and understanding of:
		Processes used in the commercial manufacture of products (continued)	<ul style="list-style-type: none"> <li>◆ manufacturing features of component parts: complexity, cross section along its length, draft angles, ejection marks, flashing, injection points, shear marks, split lines, surface finish, symbols and labels, thinning of sheet material, wall thickness</li> <li>◆ the purpose of bosses, location pins, ribs and webs</li> <li>◆ issues that influence the processes used in commercially manufactured products</li> </ul>
		Assembly methods used in the commercial manufacture of products	<ul style="list-style-type: none"> <li>◆ methods used to join material: <ul style="list-style-type: none"> <li>— adhesive, carcass and frame joints, knock-down fittings, nuts, bolts, screws, snap and press fit, riveting, spot welding, arc welding, thermal bonding</li> </ul> </li> <li>◆ methods used to identify assembly methods in commercially manufactured products</li> <li>◆ issues that influence the assembly of commercially manufactured products</li> </ul>

Assignment		Question paper	
Skill	Candidates demonstrate the ability to:	Knowledge and understanding	Candidates demonstrate knowledge and understanding of:
Produce a plan for commercial manufacture	<ul style="list-style-type: none"> <li>◆ plan the commercial manufacture of a proposal</li> </ul>	Production and planning systems	<ul style="list-style-type: none"> <li>◆ one-off production, batch production, mass production</li> <li>◆ methods used to improve production               <ul style="list-style-type: none"> <li>— automation</li> <li>— CAD/CAM</li> <li>— CNC machining</li> <li>— Gantt and flow charts</li> <li>— jigs</li> <li>— just-in-time production</li> <li>— standard components</li> </ul> </li> </ul>
		People who influence design	<ul style="list-style-type: none"> <li>◆ the roles and responsibilities of people who influence the design of products               <ul style="list-style-type: none"> <li>— designers</li> <li>— ergonomists</li> <li>— lawyers</li> <li>— production engineers</li> <li>— project manager</li> <li>— market researchers</li> <li>— materials technologists</li> </ul> </li> <li>◆ communication between members of design team</li> <li>◆ advantages and disadvantages of in-house design team and sub-contracting</li> </ul>

Assignment		Question paper	
Skill	Candidates demonstrate the ability to:	Knowledge and understanding	Candidates demonstrate knowledge and understanding of:
		Intellectual property rights	<ul style="list-style-type: none"> <li>◆ the purpose of intellectual property rights</li> <li>◆ methods of protecting intellectual property rights: copyright, design rights, patents, and trademarks</li> </ul>
		Impact of design and manufacture on society, the environment and the world of work	<ul style="list-style-type: none"> <li>◆ methods designers and manufacturers can use to limit a product's impact on the environment <ul style="list-style-type: none"> <li>— design for recyclability</li> <li>— design for re-use</li> <li>— efficiency</li> </ul> </li> <li>◆ the impact traditional and new manufacturing technologies have on society, the environment and the workforce</li> <li>◆ the impact of material on the environment and society</li> <li>◆ methods to support sustainability</li> <li>◆ investigation of a product's sustainability and its impact on the environment</li> </ul>

Skills, knowledge and understanding included in the course are appropriate to the SCQF level of the course. The SCQF level descriptors give further information on characteristics and expected performance at each SCQF level, and can be found on the SCQF website.



# Skills for learning, skills for life and skills for work

This course helps candidates to develop broad, generic skills. These skills are based on [SQA's Skills Framework: Skills for Learning, Skills for Life and Skills for Work](#) and draw from the following main skills areas:

## **2 Numeracy**

2.2 Money, time and measurement

## **4 Employability, enterprise and citizenship**

4.4 Enterprise

## **5 Thinking skills**

5.3 Applying

5.4 Analysing and evaluating

5.5 Creating

You must build these skills into the course at an appropriate level, where there are suitable opportunities.

# Course assessment

Course assessment is based on the information provided in this document.

The course assessment meets the key purposes and aims of the course by addressing:

- ◆ breadth — drawing on knowledge and skills from across the course
- ◆ challenge — requiring greater depth or extension of knowledge and/or skills
- ◆ application — requiring application of knowledge and/or skills in practical or theoretical contexts as appropriate

This enables candidates to:

- ◆ develop skills and knowledge and understanding of key concepts related to design and manufacture
- ◆ apply this knowledge and these skills to solve design problems in both practical and theoretical contexts
- ◆ demonstrate aspects of challenge and application in a practical context
- ◆ apply knowledge and skills to produce a solution to a challenging design problem
- ◆ demonstrate aspects of breadth and application in theoretical contexts
- ◆ apply breadth of knowledge and depth of understanding to produce descriptions and explanations related to theoretical design and manufacture contexts

## Course assessment structure: question paper

### Question paper

**80 marks**

The question paper has 80 marks out of a total of 170 marks for the course assessment.

It assesses knowledge and understanding from the following areas of design and manufacturing:

Area	Range of marks
◆ design	30–50 marks
◆ materials and manufacture	26–42 marks
◆ impact of design and manufacturing technologies on society, the environment, and the world of work	4–8 marks

Details of these areas can be found in the 'Skills, knowledge and understanding for the course assessment' table in this document.

The question paper has two sections:

**Section 1** has 25 marks and consists of a single question based on the design and manufacture of two similar products. The question focuses on design factors and the justification of materials and manufacturing processes used in their commercial manufacture. It follows a similar format each year and gives candidates an opportunity to demonstrate:

- ◆ knowledge and understanding of how products are influenced by materials and processes
- ◆ knowledge of how products are influenced by design factors

The question requires candidates to give reasoned responses to a range of question types.

**Section 2** has 55 marks and consists of six or seven questions that focus on the design and manufacture of commercial products and the impact design and manufacturing technologies have on society, the environment and the world of work. The questions require candidates to use integration of knowledge and understanding from across the course.

### **Setting, conducting and marking the question paper**

The question paper is set and marked by SQA, and conducted in centres under conditions specified for external examinations by SQA.

Candidates have 2 hours and 15 minutes to complete the question paper.

Specimen question papers for Higher courses are published on SQA's website. These illustrate the standard, structure and requirements of the question papers candidates sit. The specimen papers also include marking instructions.

# Course assessment structure: assignment

## Assignment

**90 marks**

The assignment has 90 marks out of a total of 170 marks for the course assessment.

The assignment assesses the ability of candidates to apply design skills to develop a proposal according to a set brief. It provides an opportunity to demonstrate the skills as listed in the 'Skills, knowledge and understanding for the course assessment' table in this document. Marks are awarded as follows:

Area	Marks
◆ carrying out research into a given brief	5 marks
◆ producing a specification	3 marks
◆ generating initial ideas	8 marks
◆ exploring ideas	12 marks
◆ refining ideas	6 marks
◆ applying knowledge and understanding of materials and assembly processes	10 marks
◆ applying knowledge and understanding of design	12 marks
◆ applying graphic techniques	12 marks
◆ demonstrating practical modelling skills	8 marks
◆ producing a plan for commercial manufacture	6 marks
◆ applying modelling techniques	8 marks

Candidates should be fully prepared before undertaking the assignment — they should have gained the design skills required and be aware of the requirements of the assessment.

## Setting, conducting and marking the assignment

The assignment is:

- ◆ set by SQA
- ◆ issued annually
- ◆ conducted under some supervision and control
- ◆ submitted to SQA for external marking

All marking is quality assured by SQA.

## **Assessment conditions**

### **Time**

Candidates generate evidence of their design skills by responding to a set brief. They produce evidence for the assignment over an extended period of time. This allows them to develop and refine their work before it is presented for assessment.

### **Supervision, control and authentication**

The assignment is produced under some supervision and control. This means that:

- ◆ candidates do not need to be directly supervised at all times
- ◆ the use of resources, including the internet, is not tightly prescribed
- ◆ the work an individual candidate submits for assessment is their own
- ◆ teachers and lecturers can provide reasonable assistance

Teachers and lecturers must put in place measures to ensure that the work an individual candidate submits for assessment is their own.

Teachers and lecturers must also retain the candidate's work between assessment sessions.

### **Resources**

There are no restrictions on the resources to which candidates may have access while producing their assignment.

### **Reasonable assistance**

Candidates must undertake the assessment independently. However, reasonable assistance may be provided prior to the formal assessment process taking place. The term 'reasonable assistance' is used to try to balance the need for support with the need to avoid giving too much assistance. If any candidates require more than what is thought to be 'reasonable assistance', they may not be ready for assessment or they may have been entered for the wrong level of qualification.

Candidates can seek clarification regarding the assessment task if they find it unclear. In this case, the clarification should normally be given to the whole class.

If a candidate is working on their assignment and is faced with more than one possible solution to a problem, then teachers and lecturers may explore options with them. The teacher or lecturer and candidate can discuss the pros and cons of each option, and the candidate can then decide on a solution based on the discussion.

Once candidates have submitted their completed assignment for assessment, it must not be changed by teachers or lecturers or candidates.

## **Evidence to be gathered**

### **Volume**

Candidates must present their work on a maximum of 12 A3-sized sheets or equivalent. This total includes four pro forma sheets which are issued annually with the assignment:

- ◆ research and specification pro formas (two sheets)
- ◆ a planning for commercial manufacture pro forma
- ◆ practical modelling skills pro forma

This information is given to indicate the volume of evidence required. No penalty will be applied.

There is no word count.

## **Grading**

Candidates' overall grades are determined by their performance across the course assessment. The course assessment is graded A–D on the basis of the total mark for all course assessment components.

### **Grade description for C**

For the award of grade C, candidates will typically have demonstrated successful performance in relation to the skills, knowledge and understanding for the course.

### **Grade description for A**

For the award of grade A, candidates will typically have demonstrated a consistently high level of performance in relation to the skills, knowledge and understanding for the course.

# Equality and inclusion

This course is designed to be as fair and as accessible as possible with no unnecessary barriers to learning or assessment.

For guidance on assessment arrangements for disabled candidates and/or those with additional support needs, please follow the link to the assessment arrangements web page: [www.sqa.org.uk/assessmentarrangements](http://www.sqa.org.uk/assessmentarrangements).

# Further information

The following reference documents provide useful information and background.

- ◆ [Higher Design and Manufacture subject page](#)
- ◆ [Assessment arrangements web page](#)
- ◆ [Building the Curriculum 3–5](#)
- ◆ [Guide to Assessment](#)
- ◆ [Guidance on conditions of assessment for coursework](#)
- ◆ [SQA Skills Framework: Skills for Learning, Skills for Life and Skills for Work](#)
- ◆ [Coursework Authenticity: A Guide for Teachers and Lecturers](#)
- ◆ [Educational Research Reports](#)
- ◆ [SQA Guidelines on e-assessment for Schools](#)
- ◆ [SQA e-assessment web page](#)

The SCQF framework, level descriptors and handbook are available on the SCQF website.



# Administrative information

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## History of changes

Version	Description of change	Date

Note: you are advised to check SQA's website to ensure you are using the most up-to-date version of this document.

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