

# General Certificate of Secondary Education

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## Design and Technology (Electronic Products) 2010

Material accompanying this Specification

- Specimen Assessment Material
- Reports on the Examination

# SPECIFICATION

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The specification will be published annually on the AQA Website ([www.aqa.org.uk](http://www.aqa.org.uk)). If there are any changes to the specification centres will be notified in print as well as on the website. The version on the Website is the definitive version of the specification.

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Or

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# Background Information

## 1

# The Revised General Certificate of Secondary Education

Following a review of the National Curriculum requirements, and the establishment of the National Qualifications Framework, all the unitary awarding bodies have revised their GCSE syllabuses for examination in 2003 onwards.

### 1.1 Changes at GCSE

#### Key Skills

All GCSE specifications must identify, as appropriate, opportunities for generating evidence on which candidates may be assessed in the “main” Key Skills of communication, application of number and information technology at the appropriate level(s). Also, where appropriate, they must identify opportunities for developing and generating evidence for addressing the “wider” Key Skills of working with others, improving own learning and performance and problem solving. Design and Technology is uniquely placed to provide opportunities for all six Key Skills.

#### Spiritual, moral, ethical, social, cultural, environmental, health and safety and European Issues

All specifications must identify ways in which the study of the subject can contribute to an awareness and understanding of these issues.

#### ICT

The National Curriculum requires that students should be given opportunities to apply and develop their ICT capacity through the use of ICT tools to support their learning. In each specification candidates will be required to make effective use of ICT in ways appropriate to the needs of the subject.

#### Tiering

In most subjects the scheme of assessment must include question papers, targeted at two tiers of grades, i.e. A\* - D and C - G.

A safety net of an allowed Grade E will be provided for candidates entered for the higher tier who just fail to achieve Grade D. The questions will still be targeted at A\* - D.

#### Citizenship

From 2002, students in England will be required to study Citizenship as a National Curriculum subject. Each GCSE specification must signpost, where appropriate, opportunities for developing citizenship knowledge, skills and understanding.

**1.2 Changes to the Design and Technology Criteria**

The main changes to the Design and Technology criteria are given below.

- a. The Aims have been simplified to reflect the National Curriculum requirements, but it should be noted that they now include a consideration of the influences of past and present design and technology on society.
- b. The Assessment Objectives have been expanded.
  - AO1 consists of materials, components, processes, techniques and industrial practices.
  - AO2 combines designing and making into one objective.
  - AO3 evaluation of processes and products includes examining the wider effects of design and technology on society
- c. Greater emphasis has been placed on ICT, particularly CAD/CAM.

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**1.3 Changes to the Design and Technology (Electronic Products) specification**

The Design and Technology (Electronic Products) specification has been revised and updated to take account of the latest developments in the teaching of electronic products.

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# Specification at a Glance

## *Design and Technology (Electronic Products)*

This specification is one of a suite of seven in Design and Technology offered by AQA. There are two tiers of assessment: Foundation (G-C) and Higher (D-A\*).

GCSE (Full Course) 3541	
Written Paper	40% of total marks
Foundation Tier	2 hours
Higher Tier	2 hours
The paper will test all Assessment Objectives through a range of questions.	
All questions are compulsory.	
Coursework Project	60% of total marks not to exceed 40 hours
Coursework consists of a project which addresses all the assessment objectives in an integrated way. The evidence required for the project consists of a 3-dimensional product and a concise design folder and/or the appropriate ICT evidence.	
GCSE (Short Course) 3551	
Written Paper	40% of total marks
Foundation Tier	1½ hours
Higher Tier	1½ hours
The paper will test all Assessment Objectives through a range of questions.	
All questions are compulsory.	
Coursework Project	60% of total marks not to exceed 20 hours
Coursework consists of a project which addresses all the assessment objectives in an integrated way. The evidence required for the project consists of a 3-dimensional product and a concise design folder and/or the appropriate ICT evidence.	

Foundation Tier	3541F	←
Higher Tier	3541H	

Foundation Tier	3551F	←
Higher Tier	3551H	

# 3

## Availability of Assessment Units and Entry Details

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### 3.1 Availability of Assessment Units

Examinations based on this Specification are available in the June examination series only.

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### 3.2 Entry Codes

Normal entry requirements apply, but the following information should be noted.

The **Subject Code** for entry to the GCSE award is 3541.

The **Subject Code** for entry to the GCSE (Short Course) award is 3551.

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### 3.3 Classification Codes

Each specification is assigned to a national classification code, indicating the subject area to which it belongs.

Centres should be aware that candidates who enter for more than one GCSE qualification with the same classification code, will have only one grade (the highest) counted for the purpose of the School and College Performance Tables.

The classification code for this specification is 9010.

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### 3.4 Private Candidates

This specification is not available for private candidates.



**3.5 Access Arrangements and Special Consideration**

AQA pays due regard to the provisions of the Disability Discrimination Act 1995 in its administration of this specification.

Arrangements may be made to enable candidates with disabilities or other difficulties to access the assessment. An example of an access arrangement is the production of a Braille paper for a candidate with a visual impairment. Special consideration may be requested for candidates whose work has been affected by illness or other exceptional circumstances.

Further details can be found in the Joint Council for Qualifications (JCQ) document:

*Access Arrangements and Special Consideration*

*Regulations and Guidance Relating to Candidates who are Eligible for Adjustments in Examination*

*GCE, AEA, GCSE, GNVQ, Entry Level & Key Skills*

This document can be viewed via the AQA web site ([www.aqa.org.uk](http://www.aqa.org.uk))

Applications for access arrangements and special consideration should be submitted to AQA by the Examinations Officer at the centre.

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**3.6 Language of Examinations**

All assessments will be through the medium of English. Assessment materials will not be provided in Welsh or Gaelge.

# Scheme of Assessment

## 4

## Introduction

### 4.1 National Criteria

This GCSE Design and Technology (Electronic Products) specification complies with the following:

- The GCSE Subject Criteria for Design and Technology;
- The GCSE, GCE and AEA Code of Practice April 2008;
- The GCSE Qualification Specific Criteria;
- The Arrangements for the Statutory Regulation of External Qualifications in England, Wales and Northern Ireland: Common Criteria.
- The National Curriculum order for Design and Technology.

### 4.2 Rationale

This specification will allow candidates to specialise in the focus area of electronic products where they will learn about designing and making quality products using appropriate electronic components and construction methods and appropriate materials to case the electronics.

### 4.3 Prior level of attainment and recommended prior learning

The specification builds on the Key Stage 3 programme of study for Design and Technology. It is expected that candidates will have followed this programme before commencing work on this specification.

It will be beneficial for candidates to have achieved at least Level 1 in the Key Skills of *Communication*, *Application of Number* and *Information Technology* to cope with the demands of this specification.

### 4.4 Progression

This qualification is a recognised part of the National Qualifications framework. As such, GCSE provides progression from Key Stage 3 through Key Stage 4 to post-16 studies. It lays an appropriate foundation for further study of Design and Technology.

## 5

## Aims

A course based on this specification should encourage candidates to

- a. demonstrate fully their design and technology capability, which requires them to combine skills with knowledge and understanding in order to design and make quality products in quantity;
- b. acquire and apply knowledge, skills and understanding through:
  - analysing and evaluating products and processes;
  - engaging in focused tasks to develop and demonstrate techniques;
  - engaging in strategies for developing ideas, planning and producing products;
  - considering how past and present design and technology, relevant to a designing and making context, affects society;
  - recognising the moral, cultural and environmental issues inherent in design and technology.

## 6

## Assessment Objectives

### 6.1 Assessment Objectives

Candidates should be able to demonstrate their design and technology capability through acquiring and applying knowledge, skills and understanding:

- a. of materials, components, processes, techniques and industrial practice;
- b. when designing and making quality products in quantity;
- c. when evaluating processes and products and examining the wider effects of design and technology on society.

### 6.2 Quality of Written Communication

Where candidates are required to produce extended written material in English, they will be assessed on the quality of written communication. Candidates will be required to:

- present relevant information in a form that suits its purposes;
- ensure that text is legible and that spelling, punctuation and grammar are accurate, so that meaning is clear.

Quality of written communication will be assessed in candidates' coursework design folders.

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# Scheme of Assessment

7.1 Full Course Assessment Units The Scheme of Assessment comprises two components.

## Written Paper

40% of the marks

Foundation Tier	2 hours	125 marks
Higher Tier	2 hours	125 marks

All questions are compulsory.

Questions will test the application of knowledge and understanding of materials, components, processes, techniques, technologies and the evaluation of commercial practices and electronic products.

Coursework Project 40 hours

60% of the marks 95 marks

The coursework project will be internally assessed and externally moderated. Full details on coursework are given in Sections 14-20 below.

The project should address all three assessment objectives in an integrated way. Candidates are required to submit a concise design folder and/or the appropriate ICT evidence and a 3-dimensional outcome.

Throughout the project candidates should address the industrial and commercial practices, and the moral, social, cultural and environmental issues, arising from their work.

Experience has shown that candidates are often highly motivated where they devise their own project outlines. This is, therefore, to be encouraged and guidelines for the preparation of outlines are given in para 15.1. Examples of suitable project outlines are given in 15.2 which can also provide starting points for candidates.

Centres should ensure that candidates embark on projects that can satisfy the coursework requirements and be completed in 40 hours.

The assessment criteria in Section 16 should be used as a guide for teachers and candidates to the type of work and the standards required.

## 7.2 Short Course Assessment Units

The Scheme of Assessment comprises two components.

### Written Paper

40% of the marks

Foundation Tier	1½ hours	100 marks
Higher Tier	1½ hours	100 marks

All questions are compulsory.

Questions will test the application of knowledge and understanding of materials, components, processes, techniques, technologies and the evaluation of commercial practices and electronic products.

Coursework Project 20 hours

60% of the marks 95 marks

The coursework project will be internally assessed and externally moderated. Full details on coursework are given in Sections 14-20 below.

For short course projects, it is essential that an appropriate project outline or brief is selected which will allow candidates to satisfy all the requirements within the 20 hours permitted. See Paragraph 14.3 for further guidance.

The project should address all three assessment objectives in an integrated way. Candidates are required to submit a concise design folder and/or the appropriate ICT evidence and a 3-dimensional outcome.

Throughout the project candidates should address the industrial and commercial practices, and the moral, social, cultural and environmental issues, arising from their work.

Experience has shown that candidates are often highly motivated where they devise their own project outlines. This is, therefore, to be encouraged and guidelines for the preparation of outlines are given in para 15.1. Examples of suitable project outlines are given in 15.2 which can also provide starting points for candidates.

The assessment criteria in Section 16 should be used as a guide for teachers and candidates to the type of work and the standards required.

### 7.3 Weighting of Assessment Objectives

For both the full and short courses, the approximate relationship between the relative percentage weighting of the Assessment Objectives (AOs) and the overall Scheme of Assessment is shown in the following table:

Assessment Objectives	Component Weightings (%)		Overall Weighting of AOs (%)
	Coursework	Written Paper	
1 Materials and Components	10	10	20
2 Designing and Making	40	20	60
3 Evaluation and Social Issues	10	10	20
<b>Overall Weighting of Units (%)</b>	<b>60</b>	<b>40</b>	<b>100</b>

Candidates' marks for each assessment unit are scaled to achieve the correct weightings.

# Subject Content

## 8

## Summary of Subject Content

### 9 Designing and Making Skills

Section 9 specifies the general designing and making skills required for both the full and short courses and the knowledge and understanding candidates should acquire.

### 10 Full Course

Section 10 specifies the Full Course content.

### 11 Short Course

Section 11 specifies the Short Course content.

Each course is presented under the following three broad areas of study:

Materials and Components;  
Design and Market Influences;  
Processes and Manufacture.

## Designing and Making Skills

Design and Technology is a practical subject area which requires the application of knowledge and understanding when developing ideas, planning, producing products and evaluating them. The distinction between Designing and Making is a convenient one to make, but in practice the two often merge. For example, research can involve not only investigating printed matter and people's opinions, but also investigating proportions, adhesives, colour, structures, circuits and materials through practical work.

The skills which follow are common to both the Full Course and the Short Course and underpin all learning and cover the programme of study for KS4 Design and Technology.

### 9.1 Designing Skills

#### Candidates should be taught:

to understand the basic design principles of line, form and colour and their application in designing;

to develop and use design briefs, detailed specifications and criteria in relation to product development;

to consider the conflicting demands that moral, cultural, economic, environmental, historical and social issues can make in the planning and in the designing of products;

to consider their own health and safety and that of makers, manufacturers, individual users and society at large;

to consider an increasing range of users of products and different societies in relation to their differing needs and values;

to anticipate and design for product maintenance;

to design for manufacturing in quantity;

to plan for quality control and quality assurance when designing products and to be aware of the difference;

to generate design proposals against stated design criteria, and to modify their proposals in the light of on-going analysis, evaluation and product development;



to use graphic techniques and ICT, including CAD to generate, develop, model and communicate design proposals;

to match materials and components with tools, equipment and processes, taking account of critical dimensions and tolerances when deciding how to manufacture the product;

to produce and use detailed working schedules that will achieve the desired objectives in the time available, setting realistic deadlines for the various stages of manufacture, identifying critical points in the making process and providing alternatives to possible problems;

to devise and apply test procedures to check the quality of their work at critical points during development, and to indicate ways of modifying and improving it when necessary;

to be flexible and adaptable in their designing, in order to respond to problems, changing circumstances and new opportunities;

to ensure that the quality of their design solution will be suitable for intended clients and consumers;

to understand the difference between quality of design and quality of manufacture and use essential criteria to evaluate the quality of products they have made and products which have been made commercially;

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## 9.2 Making Skills

### **Candidates should be taught:**

to match materials and components with tools, equipment and processes to produce quality products;

to use tools and equipment safely, accurately and efficiently to achieve an appropriate fit, finish and reliable functioning in products that match their specifications;

to use a range of industrial applications when working with familiar materials and processes;

to manufacture products singly and in quantity, including the practical application of quality control and quality assurance techniques;

to use computer-aided manufacture (CAM) in single item production and in batch or volume production;

to simulate production and assembly lines including the use of ICT;

to be adaptable in their working practices, in order to respond to changing circumstances and new opportunities;

to ensure, through testing, modification and evaluation, that the quality of their products is suitable for intended users and devise modifications where necessary that would improve performance.

## Full Course

# Materials and Components

Knowledge and understanding of materials and making processes should be of sufficient depth for candidates to make an appropriate and reasoned choice when designing and making an electronic system.

Knowledge and understanding of the materials and processes listed below may be tested in the written examination, but knowledge of the properties and characteristics of other common materials will not be tested in the written papers. It is expected that candidates through their coursework will be able to show a general knowledge of the properties and characteristics of a wider range of materials, including textiles.

It is expected that much of the knowledge and understanding of components will be delivered through consideration of the electronic building block circuits. Candidates should develop their understanding of the concepts of input, process and output and the importance of feedback in controlling systems. They should be able to describe the function of the building blocks listed below and be able to combine two or more of them to satisfy a design specification.

	<b>Candidates should:</b>	<b>Possible learning experiences</b>
10.1 <b>Materials</b>	show a working knowledge of the following materials: acrylic; polystyrene; medium density fibreboard; softwoods; mild steel; aluminium;	
10.2 <b>Processes</b>	describe in detail the following processes: vacuum forming; injection moulding;	Use vacuum forming in project work.  Evaluation of injection moulded product supported by video of the process.
10.3 <b>Manipulating Materials</b>	cut, shape and form materials to specific tolerances;	Focused practical tasks using a variety of different materials.
10.4 <b>Combining Materials</b>	describe how materials can be combined and processed to create more useful properties and how these changed materials are used in industrial application;	How metals are combined to form 'smart' materials which can be used in robotics.

	Candidates should:	Possible learning experiences
10.5 Preparing Materials	prepare materials for manufacture and use standard components;	Prepare the edges of materials before jointing.
10.6 Applying Finishes	use alternative finishes on the listed materials and justify their choice of finish in terms of aesthetics and function;	Use appropriate weatherproofing if using softwood in an outside location.
10.7 Optimum Use of Materials	use materials and components efficiently taking into account the nature of the material, the intended form and the manufacturing process to be used;	Measure the amount of waste materials for given tasks.
10.8 Components		
Power Supplies	select from the following a power source suitable for a particular purpose: solar cells, zinc-carbon batteries, alkaline batteries, nicad batteries, lead acid batteries and mains power supply units;	Sensible choice of power supply, output device and casing for a 'bike alarm'.
Mechanical Switches	describe what is meant by SPST, SPDT, DPDT;  recognise and use the following types of switches: slide, toggle, rocker, push (PTM and PTB), key, micro, reed, rotary, membrane and tilt;  know how to eliminate switch bounce;	Demonstration of switches in a variety of situations in school, e.g. alarm switches, cooker switches, computer switches, emergency switches etc.  Use of a schmitt trigger or monostable circuit.
Resistors	understand that resistors control voltage and current in electronic circuits;  use variable resistors within electronic circuits; understand that LDRs and thermistors are types of variable resistors and know how their resistance varies with light and temperature respectively;	Use variable resistors or potentiometers as variable resistors in series with sensing resistors to create input circuits.

	<b>Candidates should:</b>	<b>Possible learning experiences</b>
	<p>determine the value of a fixed resistor by using the colour code and a multimeter and use the units of measurement correctly (limited to three colour band resistors + tolerance band);</p> <p>know that resistors are commonly available in preferred value series, ie E12 (10%) and E24 (5%);</p>	<p>Use the colour code to ensure the appropriate value and accuracy of resistor is selected as part of on-going quality control.</p>
Capacitors	<p>understand that capacitors store electrical charge;</p> <p>identify polarised and non-polarised capacitors and use the units of measurement correctly;</p> <p>use a capacitor and resistor in combination to achieve a time delay;</p>	<p>Use in series with resistors to create time delays for monostable and astable circuits.</p>
Diodes	<p>understand that diodes allow current to flow in only one direction;</p> <p>use a diode to protect components from back emf;</p> <p>use an LED in electronic circuits;</p>	<p>Use a bi-colour LED with an operational amplifier as part of a temperature sensor.</p>
Field Effect Transistors	<p>know how and when to use a field effect transistor;</p>	<p>Use a FET in a latching touch switch circuit to satisfy output current requirements.</p>
Thyristors	<p>use a thyristor as a latch (a simple flip-flop);</p>	<p>Use a thyristor to create a simple latching and flashing torch.</p>
Relays	<p>understand that relays are used to interface between electrical circuits without any electrical connection;</p> <p>use a relay as a latch;</p> <p>know how to select an appropriate relay for a particular purpose;</p>	<p>Use to latch an alarm output which uses a different power supply than the control circuit.</p>

	<b>Candidates should:</b>	<b>Possible learning experiences</b>
Operational Amplifiers	<p>understand the function of an operational amplifier and be able to describe the use of the non-inverting and inverting inputs;</p> <p>use operational amplifiers which require a single power supply or a dual power supply;</p> <p>use an operational amplifier as a comparator and an inverting amplifier;</p> <p>know how to limit the gain of an operational amplifier by using a feedback resistor (negative feedback only);</p>	<p>Demonstration using comparator circuit with two LED output in opposite polarities.</p> <p>Use 741 and LM358 to build comparator circuits.</p> <p>Use a comparator to provide sensitive monitoring for a variety of situations.</p>
Logic	<p>understand that logic is used when circuits require more than one input;</p> <p>use switches connected in series or parallel to produce the AND and OR functions;</p> <p>understand that logic gates respond to and output digital signals and distinguish these from analogue signals;</p> <p>use the following logic gates and construct their truth tables (limited to 2 inputs): AND, OR, NAND, NOR, NOT and XOR;</p> <p>solve logic problems using gates in combination;</p>	<p>Use logic in control circuits.</p> <p>Demonstrate safety systems on machines.</p> <p>Use NAND gates when considering component redundancy and limiting stock requirements.</p>
Peripheral Interface Controllers	<p>demonstrate an awareness that a programming language can be used to integrate a variety of sub-system routines into one program and can be downloaded into a PIC;</p>	<p>Demonstrate how PICs are used in domestic products such as microwave ovens and washing machines. Candidates write a program for a washing cycle using a generic form of programming language, e.g. When input 1 goes high; Wait 10; Switch on output 1.</p>

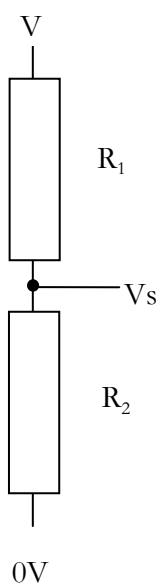
	<b>Candidates should:</b>	<b>Possible learning experiences</b>
	<p>select erasable and non-erasable PICs for particular purposes;</p> <p>use a programming language to write simple sub-system routines including timing, latching, pulse generation and counting;</p> <p>show how simple sub-system routines can be combined to produce complex outcomes;</p> <p>explain the need for a 'clock' as part of the PIC circuitry;</p> <p>use digital and analogue input sensors with PICs;</p> <p>interface PICs with output devices which generate light or sound;</p> <p>use decimal numbers to control the logic state of up to 8 outputs;</p>	<p>Demonstrate or search catalogues to find different forms of erasable PICs, e.g. ultra-violet, electronic.</p> <p>Use ICT to write a program based on a system diagram.</p> <p>Use the screen simulation facilities to test the functionality of a programme.</p> <p>If appropriate design a project board using a crystal oscillator.</p> <p>Use potential dividers as input circuits for PICs.</p> <p>Use transistors, FETs and Relays to switch on outputs which require a higher current than the PIC can supply.</p>
<b>Construction Techniques</b>	<p>design and build electronic circuits of high quality using PCBs or veroboard;</p> <p>use temporary construction methods to prototype circuits including breadboards;</p>	

## 10.9 Electronic Building Blocks

<b>Potential Dividers</b>	<p>use potential dividers to control voltages in a circuit;</p>	<p>Use LDRs, thermistors and moisture sensors to create potential dividers in which <math>V_s</math> will rise as the conditions get hot, cold, dark, light, wet and dry.</p>
<b>Electronic Switches</b>	<p>use transistors and logic gates as electronic switches;</p>	<p>Use transistors and logic gates in temperature control or touch switch situations.</p>

	<b>Candidates should:</b>	<b>Possible learning experiences</b>
Monostable Timers	use timer ICs (including the 555) to create monostable circuits capable of giving time on delays and time off delays;	Use a variable delay kitchen timer.
Astable Circuits (Pulse Generators)	use logic gates and timer ICs (including 555) to produce pulse generators with both equal and unequal mark/space ratios at a range of frequencies;	Use a fixed ratio astable circuit in a metronome. Use a variable ratio astable in a motor speed control circuit.
Counters	use decade counters to achieve simple counting ie CMOS4017IC;	Reset a counter so that it can behave as a die which counts from 1 – 6.  Use counting circuits to monitor lives lost in game projects.
Interface Devices	select and use an appropriate amplifier/transducer driver for a particular purpose (limited to Darlington drivers, op-amps, field effect transistors and bi-polar transistors);	Use an operational amplifier as a voltage amplifier and/or use a FET as a power switch.
Output Devices	describe applications for, and use buzzers, lamps, bells, LEDs, loudspeakers and piezo electric transducers;	Use a variety of output devices in project work and demonstrate specialist output devices such as high decibel buzzers.

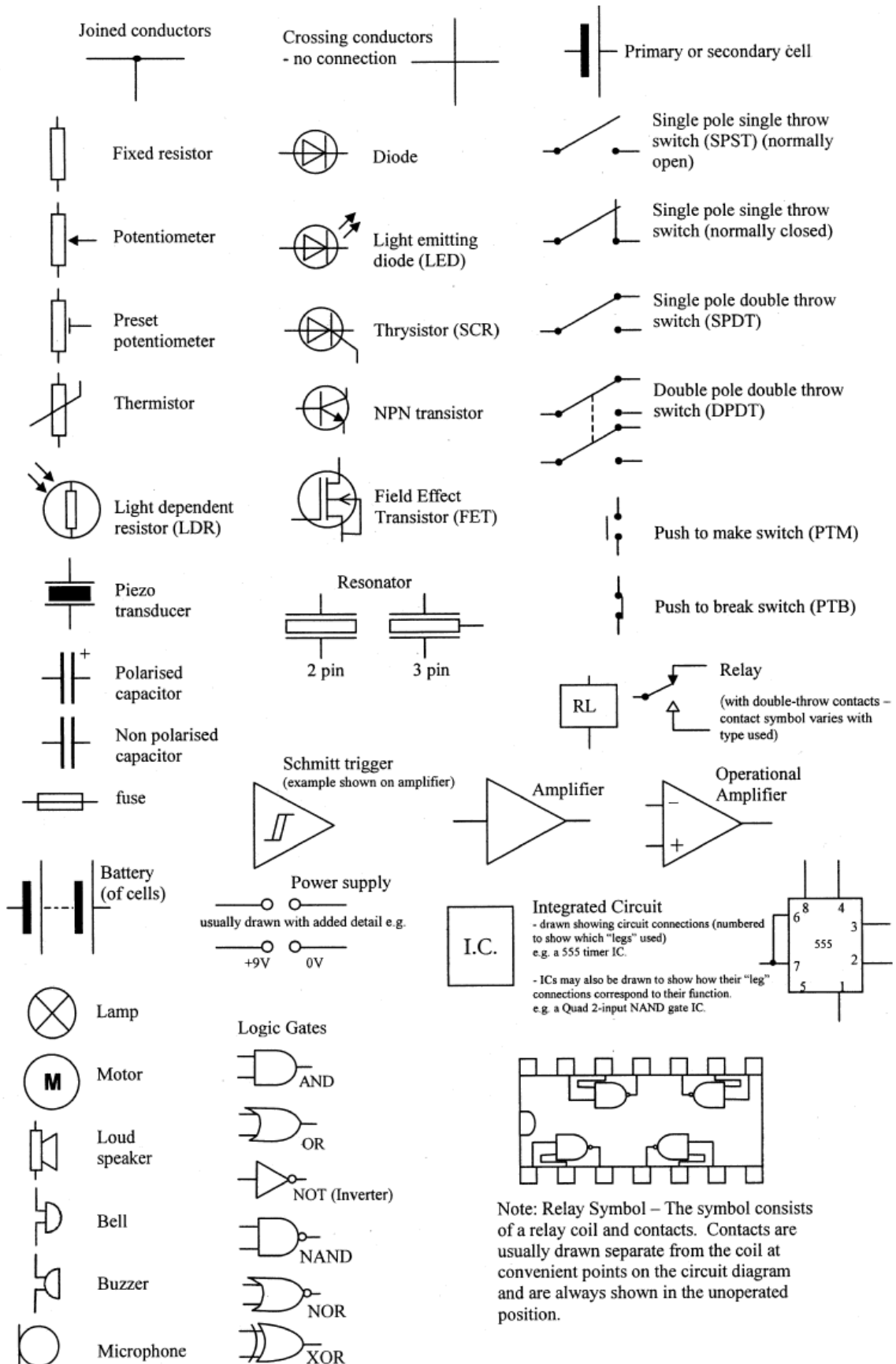


	<b>Candidates should:</b>	<b>Possible learning experiences</b>
<b>10.10 Calculations</b>	use the formulae listed below: (these formulae will be listed in the examination paper);	Record the use of calculations when designing circuits.
Potential Difference	Potential Difference = Current × Resistance	(V = I × R)
Series Resistors	$R_{\text{total}} = R_1 + R_2 + R_3$ etc	
Parallel Resistors	$\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$	
Electrical Power	Electrical Power = Current × Potential Difference	(P = I × V)
Potential Divider	 $V_s = \frac{R_2}{R_1 + R_2} \times V$ <p>where <math>V_s</math> = signal value  <math>V</math> = supply voltage  <math>R_1</math> and <math>R_2</math> are resistance values</p>	
Inverting Op-Amps	Gain = $-\frac{R_f}{R_{in}}$	Where $R_f$ = feedback resistor value $R_{in}$ = input resistor value
Time Constant	Time Constant $\approx$ Resistance × Capacitance	(T $\approx$ R × C)
Astable Frequency for 555	$f = \frac{1.44}{(R_1 + 2R_2) \times C}$	
Pulse duration	$= \frac{1}{\text{frequency}}$	
Time High	$T_h = 0.693 \times (R_1 + R_2) \times C$	
Time Low	$T_l = 0.693 \times R_2 \times C$	
Mark Space Ratio	$= \frac{T_h}{T_l}$	

**Candidates should:**

**10.11 Circuit Symbols**

recognise and draw the circuit symbols shown below: (these symbols will be used in written examinations);



**Note: Relay Symbol** – The symbol consists of a relay coil and contacts. Contacts are usually drawn separate from the coil at convenient points on the circuit diagram and are always shown in the unoperated position.

## Design and Market Influences

Candidates are required to demonstrate their design and technology capability through acquiring and applying knowledge, skills and understanding when evaluating processes and products and examining the wider effects of design and technology on society.

	<b>Candidates should:</b>	<b>Possible learning experiences</b>
<b>10.12 Evaluation Techniques</b>		
Adaptations	generate design proposals to satisfy the brief and specifications, and modify their proposals in the light of ongoing analysis and product development including prototyping;	Devise an end user evaluation of a prototype system.
Quality	<p>suggest modifications which will improve the performance of the product and match previously identified moral, cultural or environmental considerations;</p> <p>know why quality is important at all stages of the making process and how testing can be applied to industrial products and candidates' own work;</p>	<p>Consider ways of reducing pollution in a manufacturing system.</p> <p>Check the correct operation of control systems before they are combined into a finished product.</p>
<b>10.13 Social, Cultural, Moral and Environmental Issues</b>	<p>consider the following when examining the wider effects of design and technology on society when designing and making solutions:</p> <p>pollution and health hazards associated with electronic control systems;</p> <p>automation and its implications on job opportunities;</p> <p>industrial applications of electronic control systems;</p> <p>identify and describe the use of micro-processors within society and explain the positive and negative effects;</p>	<p>Videos of industrial operations.</p> <p>Discussions about the use of green technologies to protect the environment.</p> <p>Consideration of the growing demand for mass customisation.</p> <p>Research assignments into the effect control systems have had on various industries, e.g. motor, commerce.</p> <p>Demonstrate the use of microprocessors in common household items.</p>

**Candidates should:**

recognise the moral issues relating to personal information stored in computer databases;

show awareness of the need for software licensing and the Data Protection Act;

be aware of the social, economic and environmental changes brought about by the development of electronic control technology;

**Possible learning experiences**

Video or discussions examining the wider effect that Design and Technology has on society.

Use of specialist software packages to produce a small scale working circuit for eventual inclusion in a product and ensuring that their design is not used by others.

Discuss the increasing access to cheap, reliable products due to the development of robotic production lines. Investigate the development and change of consumer products during the last 20 years.

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**10.14 Health and Safety**

show awareness of the implications of Health and Safety when designing and making;

apply safe practice and procedures when working with electronic systems in practical situations;

recognise hazards in products, activities and environments when working with electricity;

work safely with tools, equipment and materials, in practical activities and in different environments, including those that are unfamiliar;

recognise hazards, assess consequent risks and take steps to control the risks to themselves and others in a variety of workshop situations including: the use of tools, equipment and processes to manipulate resistant materials and construct electronic systems;

distinguish between immediate and cumulative risks;

Discussion of the Health and Safety implications of a product for the manufacturers and the end users.

Consider the effects of prolonged use on users, comfortable working positions, logic for safety switches etc.

Dangers of heat and electricity to themselves and to those around them when using a soldering iron. Discuss relative danger of a variety of power supplies.

Visit local industry making note of health and safety procedures.

Conduct a formal hazard analysis in the school workshop.

Compare risks associated with dusty environments, e.g. fire, respiratory.

**Candidates should:**

be aware of ways to manage environments to ensure the safety of themselves and others;

use equipment and components safely and act in an appropriate manner in the event of an accident;

understand the following types of safety features: fuses, earthing and RCDs;

**Possible learning experiences**

Study the use of signs in various environments.

Design a sign to communicate safe working practices and the location of school designated first aiders.

**10.15 Information and Communication Technology**

**Using CAD**

use computer aided design (CAD);

Use circuit symbols in conjunction with a graphics package to produce circuit diagrams for use in coursework projects. Develop suitable track layouts from circuit diagrams taking into account the requirements of the product as a whole.

**PCB Design**

use CAD to generate designs for electronic circuits;

Use CAD to design, retrieve or modify electronic circuits for production.

produce PCB track layouts using CAD;

Design the PCB layout using a generic draw program or a commercially produced CAD program.

**Modelling**

use simple computer modelling techniques to test system proposals or calculate values;

Use a computer modelling program to test a circuit idea or a spreadsheet to write a program which will give correct component values.

Using CAM

**Candidates should:**

use computer aided manufacturing (CAM);

**Possible learning experiences**

Use the photoetch or engraving methods to produce a PCB, e.g. to make a mask to be used in PCB production or use an engraver to cut appropriate cams. Adoption of new technologies, e.g. using a CNC milling machine to produce moulds for injection moulding, using a CNC router to produce MDF moulds for vacuum forming.

## **Processes and Manufacture**

Candidates are expected to be able to manufacture products using a range of materials and processes. They should have a broad understanding of manufacturing systems for the production of commercial products both in the industrial and the developing world.

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**Candidates should:**

**Possible learning experiences**

10.16 **Systems and Control Procedures**

analyse and design open and closed loop electronic systems using the terms INPUT, PROCESS, OUTPUT and FEEDBACK;

use system diagrams to demonstrate the relationship between sub-systems;

devise criteria to analyse the performance of a system;

Robotics – pick and place machines for PCB assembly, thermostat and timer on central heating control, greenhouse environment control.

Recognise and use a system which will satisfy part of a brief – dedicated ICs.

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10.17 **Industrial Practices**

anticipate the implications that the volume of production will have on the design of a product;

The use of simple jigs and fixtures to aid manufacture, when consistency in component size is required.

**Candidates should:**

use a range of industrial applications when working with familiar materials and processes;

take account of industrial considerations and constraints when designing and making;

demonstrate knowledge of industrial practices;

use industrial practices when designing and making.

**Possible learning experiences**

Record their use through questionnaires, surveys, CAD and CAM systems, brainstorming, specifications and test procedures when designing and making. Produce costings for their product considering volume of production and apply good Health and Safety practices when working.

E.g. division of labour, methods and scale of production, quality control, quality assurance, objective testing. Assess the cost of health and safety procedures. Analyse products in terms of environmental costs and social benefits.

Comparison of the processes used by large electronics companies compared to those used by small companies. Use of industrial visit or suitable video showing an industrial process. A classroom exercise that can simulate batch production.

Use research and development tools such as questionnaires, brainstorming and search for information using written and electronic sources.

## Short Course

### *Materials and Components*

Knowledge and understanding of materials and making processes should be of sufficient depth for candidates to make an appropriate and reasoned choice when designing and making an electronic system.

Knowledge and understanding of the materials and processes listed below may be tested in the written examination, but knowledge of the properties and characteristics of other common materials will not be tested in the written papers. It is expected that candidates through their coursework will be able to show a general knowledge of the properties and characteristics of a wider range of materials, including textiles.

It is expected that much of the knowledge and understanding of components will be delivered through consideration of the electronic building block circuits. Candidates should develop their understanding of the concepts of input, process and output and the importance of feedback in controlling systems. They should be able to describe the function of the building blocks listed below and be able to use them to satisfy a design specification.

	<b>Candidates should:</b>	<b>Possible learning experiences</b>
11.1	<b>Materials</b>	show a working knowledge of the following materials: polystyrene; softwoods; mild steel;
11.2	<b>Processes</b>	describe in detail the following process: vacuum forming; Use vacuum forming in project work.
11.3	<b>Manipulating Materials</b>	cut, shape and form materials to specific tolerances; Focused Practical Tasks using a variety of different materials.
11.4	<b>Preparing Materials</b>	prepare materials for manufacture and use standard components; Prepare the edges of materials before jointing.

	<b>Candidates should:</b>	<b>Possible learning experiences</b>
11.1	<b>Materials</b>	show a working knowledge of the following materials: polystyrene; softwoods; mild steel;
11.2	<b>Processes</b>	describe in detail the following process: vacuum forming; Use vacuum forming in project work.
11.3	<b>Manipulating Materials</b>	cut, shape and form materials to specific tolerances; Focused Practical Tasks using a variety of different materials.
11.4	<b>Preparing Materials</b>	prepare materials for manufacture and use standard components; Prepare the edges of materials before jointing.



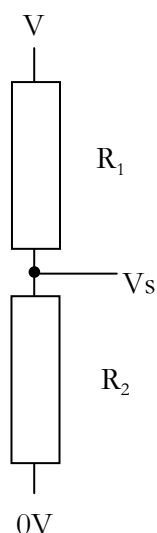
	<b>Candidates should:</b>	<b>Possible learning experiences</b>
<b>11.5 Components</b>		
Mechanical Switches	<p>describe what is meant by SPST, SPDT, DPDT;</p> <p>recognise and use the following types of switches: slide, toggle, push (PTM and PTB), key, micro, reed and tilt;</p>	Demonstration of switches in a variety of situations in school, e.g. alarm switches, cooker switches, computer switches, emergency switches etc.
Resistors	<p>understand that resistors control voltage and current in electronic circuits;</p> <p>use variable resistors within electronic circuits; understand that LDRs and thermistors are types of variable resistors and know how their resistance varies with light and temperature respectively;</p> <p>determine the value of a fixed resistor by using the colour code and a multimeter and use the units of measurement correctly (limited to three colour band resistors + tolerance band);</p>	<p>Use variable resistors or potentiometers as variable resistors in series with sensing resistors to create input circuits.</p> <p>Use the colour code to ensure the appropriate value and accuracy of resistor is selected as part of on-going quality control.</p>
Capacitors	<p>understand that capacitors store electrical charge;</p> <p>identify polarised and non-polarised capacitors and use the units of measurement correctly;</p> <p>use a capacitor and resistor in combination to achieve a time delay;</p>	Use in series with resistors to create time delays for monostable and astable circuits.
Thyristors	use a thyristor as a latch (a simple flip-flop);	Use a thyristor to create a simple latching and flashing torch.
Peripheral Interface Controllers	demonstrate an awareness that a programming language can be used to integrate a variety of sub-system routines into one program and can be downloaded into a PIC;	Demonstrate how PICs are used in domestic products such as microwave ovens and washing machines. Candidates write a program for a washing cycle using a generic form of programming language, e.g. When input 1 goes high; Wait 10; Switch on output 1.

	<b>Candidates should:</b>	<b>Possible learning experiences</b>
	<p>select erasable and non-erasable PICs for particular purposes;</p> <p>use a programming language to write simple sub-system routines including timing, latching, pulse generation;</p> <p>use digital and analogue input sensors with PICs;</p> <p>interface PICs with output devices which generate light or sound;</p> <p>use decimal numbers to control the logic state of up to 8 outputs;</p>	<p>Demonstrate or search catalogues to find different forms of erasable PICs, e.g. ultra-violet, electronic.</p> <p>Use ICT to write a program based on a system diagram.</p> <p>Use potential dividers as input circuits for PICs.</p> <p>Use transistors, FETs and Relays to switch on outputs which require a higher current than the PIC can supply.</p>
Construction Techniques	<p>design and build electronic circuits of high quality using PCBs or veroboard;</p> <p>use temporary construction methods to prototype circuits including breadboards;</p>	

## 11.6 Electronic Building Blocks

Potential Dividers	use potential dividers to control voltages in a circuit;	Use LDRs, thermistors and moisture sensors to create potential dividers in which Vs will rise as the conditions get hot, cold, dark, light, wet and dry.
Interface Devices	select and use an appropriate interface device driver for a particular purpose (limited to, bipolar transistors and relays);	
Monostable Timers	use timer ICs (including the 555) to create monostable circuits capable of giving time on delays and time off delays;	Use a variable delay kitchen timer.
Astable Circuits (Pulse Generators)	use timer ICs (including 555) to produce pulse generators with equal mark/ space ratio at a range of frequencies;	Use a fixed ratio astable circuit in a metronome. Use a variable ratio astable in a motor speed control circuit.

	<b>Candidates should:</b>	<b>Possible learning experiences</b>
<b>11.7 Calculations</b>	use the formulae listed below: (the formulae will be listed in the examination paper);	Record the use of calculations when designing circuits.
Potential Difference	Potential Difference = Current × Resistance	( $V = I \times R$ )
Series Resistors	$R_{\text{total}} = R_1 + R_2 + R_3$ etc	
Electrical Power	Electrical Power = Current × Potential Difference	( $P = I \times V$ )
Potential Divider		



$$V_s = \frac{R_2}{R_1 + R_2} \times V$$

where  $V_s$  = signal value  
 $V$  = supply voltage  
 $R_1$  and  $R_2$  are resistance values

Time Constant    Time Constant  $\approx$  Resistance × Capacitance    ( $T \approx R \times C$ )

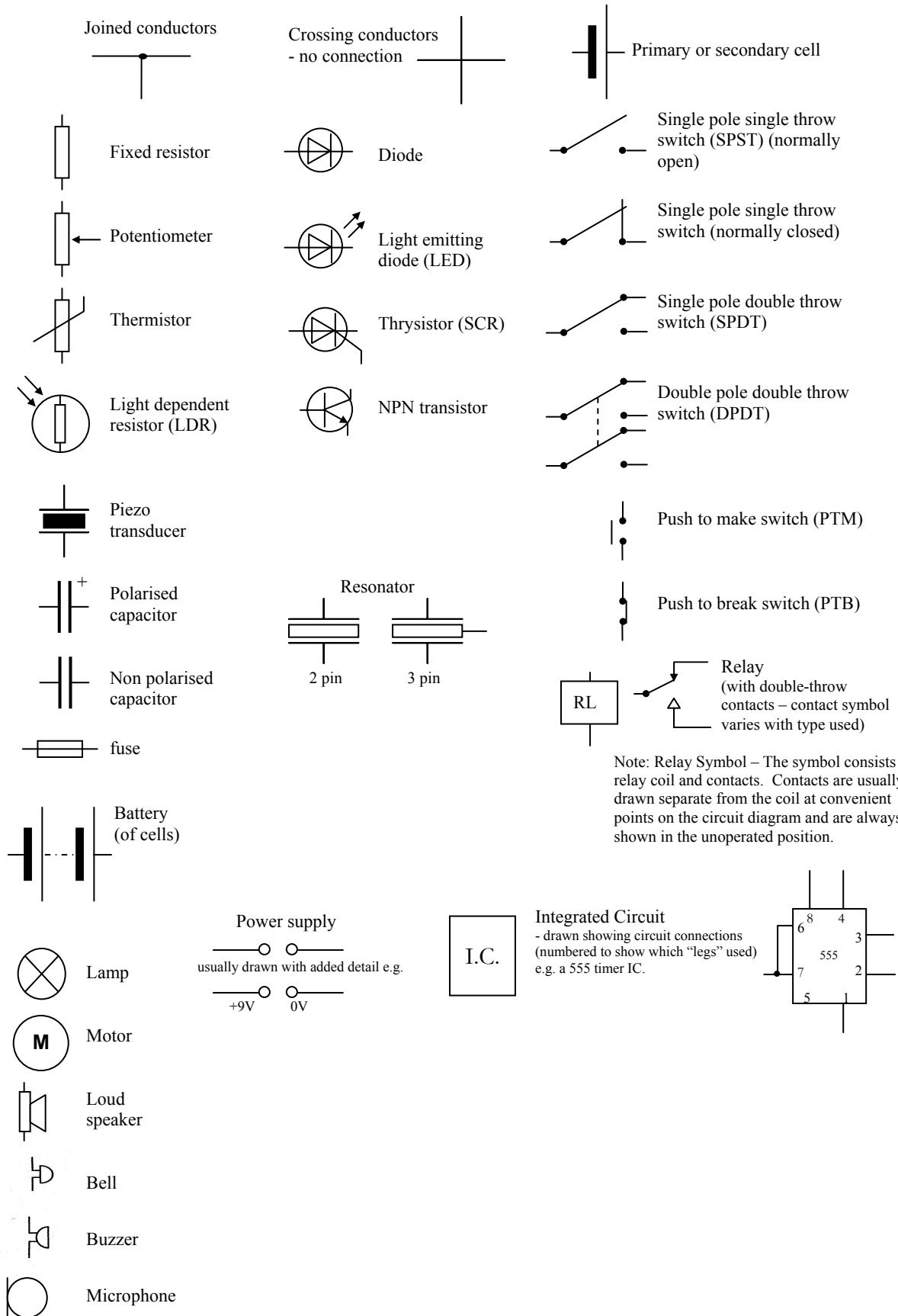
Astable  
 Frequency for 555     $f = \frac{1.44}{(R_1 + 2R_2) \times C}$

Pulse duration     $= \frac{1}{\text{frequency}}$

**Candidates should:**

**11.8 Circuit Symbols**

recognise and draw the circuit symbols shown below: (these symbols will be used in written examinations);



Note: Relay Symbol – The symbol consists of a relay coil and contacts. Contacts are usually drawn separate from the coil at convenient points on the circuit diagram and are always shown in the unoperated position.

## Design and Market Influences

Candidates are required to demonstrate their design and technology capability through acquiring and applying knowledge, skills and understanding when evaluating processes and products and examining the wider effects of design and technology on society.

	<b>Candidates should:</b>	<b>Possible learning experiences</b>
<b>11.9 Evaluation Techniques</b>		
Adaptations	generate design proposals to satisfy the brief and specifications and modify their proposals in the light of ongoing analysis and product development including prototyping;	Devise an end user evaluation of a prototype system.
Quality	<p>suggest modifications which will improve the performance of the product and match previously identified moral, cultural or environmental considerations;</p> <p>know why quality is important at all stages of the making process and how testing can be applied to industrial products and candidates' own work;</p>	<p>Consider ways of reducing pollution in a manufacturing system.</p> <p>Check the correct operation of control systems before they are combined into a finished product.</p>
<b>11.10 Social, Cultural, Moral and Environmental Issues</b>	<p>consider the following when examining the wider effects of design and technology on society when designing and making solutions;</p> <p>automation and its implications on job opportunities;</p> <p>industrial applications of electronic control systems;</p> <p>identify and describe the use of micro-processors within society and explain the positive and negative effects;</p>	<p>Videos of industrial operations.</p> <p>Discussions about the use of green technologies to protect the environment.</p> <p>Consideration of the growing demand for mass customisation.</p> <p>Research assignments into the effect control systems have had on various industries, e.g. motor, commerce.</p> <p>Demonstrate the use of microprocessors in common household items.</p> <p>Video or discussions examining the wider effect that Design and Technology has on society.</p>

**Candidates should:**

be aware of the social, economic and environmental changes brought about by the development of electronic control technology;

**Possible learning experiences**

Discuss the increasing access to cheap, reliable products due to the development of robotic production lines. Investigate the development and change of consumer products during the last 20 years.

**11.11 Health and Safety**

show awareness of the implications of Health and Safety when designing and making;

Discussion of the Health and Safety implications of a product for the manufacturers and the end users.

apply safe practice and procedures when working with electronic systems in practical situations;

Consider the effects of prolonged use on users, comfortable working positions, logic for safety switches etc.

recognise hazards in products, activities and environments when working with electricity;

Dangers of heat and electricity to themselves and to those around them when using a soldering iron. Discuss relative danger of a variety of power supplies.

work safely with tools, equipment and materials, in practical activities and in different environments, including those that are unfamiliar;

Visit local industry making note of health and safety procedures.

recognise hazards, assess consequent risks and take steps to control the risks to themselves and others in a variety of workshop situations including: the use of tools, equipment and processes to manipulate resistant materials and construct electronic systems;

Conduct a formal hazard analysis in the school workshop.

distinguish between immediate and cumulative risks;

Compare risks associated with dusty environments, e.g. fire, respiratory.

be aware of ways to manage environments to ensure the safety of themselves and others;

Study the use of signs in various environments.

use equipment and components safely and act in an appropriate manner in the event of an accident;

Design a sign to communicate safe working practices and the location of school designated first aiders.

**Candidates should:**

understand the following types of safety features: fuses, earthing and RCDs;

**Possible learning experiences**

**11.12 Information and Communication Technology**

Using CAD

use computer aided design (CAD);

Use circuit symbols in conjunction with a graphics package to produce circuit diagrams for use in coursework projects. Develop suitable track layouts from circuit diagrams taking into account the requirements of the product as a whole.

PCB Design

use CAD to generate designs for electronic circuits;

Use CAD to design, retrieve or modify electronic circuits for production.

produce PCB track layouts using CAD;

Design the PCB layout using a generic draw program or a commercially produced CAD program.

Modelling

use simple computer modelling techniques to test system proposals or calculate values;

Use a computer modelling program to test a circuit idea or a spreadsheet to write a program which will give correct component values.

Using CAM

use computer aided manufacturing (CAM);

Use the photoetch or engraving methods to produce a PCB, e.g. to make a mask to be used in PCB production or use an engraver to cut appropriate cams. Adoption of new technologies, e.g. using a CNC milling machine to produce moulds for injection moulding, using a CNC router to produce MDF moulds for vacuum forming.

## Processes and Manufacture

Candidates are expected to be able to manufacture products using a range of materials and processes. They should have a broad understanding of manufacturing systems for the production of commercial products both in the industrial and the developing world.

### Candidates should:

### Possible learning experiences

#### 11.13 Systems and Control Procedures

analyse and design open and closed loop electronic systems using the terms INPUT, PROCESS, OUTPUT, and FEEDBACK;

use system diagrams to demonstrate the relationship between sub-systems;

Robotics – pick and place machines for PCB assembly, thermostat and timer on central heating control, greenhouse environment control

Recognise and use a system which will satisfy part of a brief – dedicated ICs.

#### 11.14 Industrial Practices

anticipate the implications that the volume of production will have on the design of a product;

use a range of industrial applications when working with familiar materials and processes;

take account of industrial considerations and constraints when designing and making;

demonstrate knowledge of industrial practices;

The use of simple jigs and fixtures to aid manufacture, when consistency in component size is required.

Record their use through questionnaires, surveys, CAD and CAM systems, brainstorming, specifications and test procedures when designing and making. Produce costings for their product considering volume of production and apply good Health and Safety practices when working.

E.g. division of labour, methods and scale of production, quality control, quality assurance, objective testing. Assess the cost of health and safety procedures. Analyse products in terms of environmental costs and social benefits.

Comparison of the processes used by large electronics companies compared to those used by small companies. Use of industrial visit or suitable video showing an industrial process. A classroom exercise that can simulate batch production.



**Candidates should:**

use industrial practices when designing and making.

**Possible learning experiences**

Use research and development tools such as questionnaires, brainstorming and search for information using written and electronic sources.

## Key Skills and Other Issues

12

# Key Skills – Teaching, Developing and Providing Opportunities for Generating Evidence

### 12.1 Introduction

The Key Skills Qualification requires candidates to demonstrate levels of achievement in the Key Skills of *Application of Number, Communication and Information Technology*.

The units for the ‘wider’ Key Skills of *Improving own Learning and Performance, Working with Others* and *Problem-Solving* are also available. The acquisition and demonstration of ability in these ‘wider’ Key Skills is deemed highly desirable for all candidates, but they do not form part of the Key Skills Qualification. Design and Technology, however, does offer a unique opportunity for candidates to provide evidence for all six Key Skills.

Copies of the Key Skills Units may be downloaded from the QCA Website (<http://www.qca.org.uk/keyskills>).

The units for each Key Skill comprise three sections:

- A What you need to know.
- B What you must do.
- C Guidance.

Candidates following a course of study based on this Specification for Design and Technology (Electronic Products) can be offered opportunities to develop and generate evidence of attainment in aspects of the Key Skills of *Application of Number, Communication, Information Technology, Improving own Learning and Performance, Working with Others* and *Problem-Solving*. Areas of study and learning that can be used to encourage the acquisition and use of Key Skills, and to provide opportunities to generate evidence for Part B of the units, are signposted below.

### 12.2 Key Skills Opportunities in Design and Technology (Electronic Products)

The broad and multi-disciplinary nature of Design and Technology makes it an ideal vehicle to help candidates develop their knowledge and understanding of all Key Skills and to produce evidence of their application. It should be noted that, while *Working with Others* is an important aspect of Design and Technology, the work candidates submit for coursework assessment must be their own.

**Application of Number Level 1**

<b>What you must do ...</b>	<b>Signposting of Opportunities for Generating Evidence in Subject Content</b>
<b>N1.1</b> Interpret information from different sources	10.1, 10.4, 10.8, 10.13, 10.14, 11.1, 11.5, 11.10, 11.11
<b>N1.2</b> Carry out calculations	10.3, 10.7, 10.10, 11.3, 11.7
<b>N1.3</b> Interpret results and present findings	10.12, 11.9

**Application of Number Level 2**

<b>What you must do ...</b>	<b>Signposting of Opportunities for Generating Evidence in Subject Content</b>
<b>N2.1</b> Interpret information from different sources	9.1, 10.1, 10.4, 10.8, 10.13, 10.14, 11.1, 11.5, 11.10, 11.11
<b>N2.2</b> Carry out calculations	10.3, 10.7, 10.10, 11.3, 11.7
<b>N2.3</b> Interpret results and present findings	9.1, 10.12, 11.9

**Communication Level 1**

<b>What you must do ...</b>	<b>Signposting of Opportunities for Generating Evidence in Subject Content</b>
<b>C1.1</b> Take part in discussions	9.1, 10.12, 10.13, 10.14, 11.9, 11.10, 11.11
<b>C1.2</b> Read and obtain information	9.1, 10.1, 10.12, 10.13, 11.1, 11.9, 11.10
<b>C1.3</b> Write different types of documents	9.1, 10.12, 10.15, 11.9, 11.12

### Communication Level 2

What you must do ...	Signposting of Opportunities for Generating Evidence in Subject Content
<b>C2.1a</b> Contribute to discussions	9.1, 10.12, 10.13, 10.14, 11.9, 11.10, 11.11
<b>C2.1b</b> Give a short talk	10.13, 11.10
<b>C2.2</b> Read and summarise information	9.1, 10.1, 10.12, 10.13, 11.1, 11.9, 11.10
<b>C2.3</b> Write different types of documents	9.1, 10.12, 10.15, 11.9, 11.1

### Information Technology Level 1

What you must do ...	Signposting of Opportunities for Generating Evidence in Subject Content
<b>IT1.1</b> Find, explore and develop information	9.1, 10.1, 10.4, 10.16, 10.17, 11.1, 11.13, 11.14
<b>IT1.2</b> Present information, including text, numbers and images	9.1, 10.12, 10.15, 11.9, 11.12

### Information Technology Level 2

What you must do ...	Signposting of Opportunities for Generating Evidence in Subject Content
<b>IT2.1</b> Search for and select information	9.1, 10.1, 10.4, 10.17, 11.1, 11.14
<b>IT2.2</b> Explore and develop information and derive new information	9.1, 10.1, 10.4, 10.15, 11.1, 11.12
<b>IT2.3</b> Present combined information, including text, numbers and images	9.1, 10.12, 10.15, 10.16, 11.9, 11.12, 11.13

**Working with Others Level 1**

<b>What you must do ...</b>	<b>Signposting of Opportunities for Generating Evidence in Subject Content</b>
<b>WO1.1</b> Confirm what needs to be done and who is to do it	9.1, 10.17, 11.14
<b>WO1.2</b> Work towards agreed objectives	9.1, 10.17, 11.14
<b>WO1.3</b> Identify progress and suggest improvements	9.1, 10.17, 11.14

**Working with Others Level 2**

<b>What you must do ...</b>	<b>Signposting of Opportunities for Generating Evidence in Subject Content</b>
<b>WO2.1</b> Plan work and confirm working arrangements	9.1, 10.17, 11.14
<b>WO2.2</b> Work cooperatively towards achieving identified objectives	9.1, 10.17, 11.14
<b>WO2.3</b> Exchange information on progress and agree ways of improving work with others	9.1, 10.17, 11.14

**Improving own Learning and Performance Level 1**

<b>What you must do ...</b>	<b>Signposting of Opportunities for Generating Evidence in Subject Content</b>
<b>LP1.1</b> Confirm, short term targets and plan how these will be met	9.1, 10.12, 11.9
<b>LP1.2</b> Follow plan to meet targets and improve performance	9.1, 10.12, 11.9
<b>LP1.3</b> Review progress and achievement.	9.1, 10.12, 11.9

### Improving Own Learning and Performance Level 2

What you must do ...	Signposting of Opportunities for Generating Evidence in Subject Content
<b>LP2.1</b> Help set short-term targets and plan how these will be met	9.1, 10.12, 11.9
<b>LP2.2</b> Use plan and support from others, to meet targets	9.1, 10.12, 11.9
<b>LP2.3</b> Review progress and identify evidence of achievements	9.1, 9.2, 10.12, 11.9

### Problem Solving Level 1

What you must do ...	Signposting of Opportunities for Generating Evidence in Subject Content
<b>PS1.1</b> Confirm understanding of given problems	9.1, 10.12, 11.9
<b>PS1.2</b> Plan and try out ways of solving problems	9.1, 10.12, 11.9
<b>PS1.3</b> Check if problems have been solved and describe the results	9.1, 9.2, 10.12, 11.9

**Problem Solving Level 2**

<b>What you must do ...</b>	<b>Signposting of Opportunities for Generating Evidence in Subject Content</b>
<b>PS2.1</b> Identify problems and come up with ways of solving them	9.1, 10.12, 11.9
<b>PS2.2</b> Plan and try out options	9.1, 10.12, 11.9
<b>PS2.3</b> Apply given methods to check if problems have been solved and describe the results	9.1, 9.2, 10.12, 11.9

**12.3 Further Guidance**

More specific guidance and examples of tasks that can provide evidence of single Key Skills, or composite tasks that can provide evidence of more than one Key Skill are given in the AQA specification support material, particularly the Teachers' Guide.

# 13

## Spiritual, Moral, Ethical, Social, Cultural and Other Issues

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- 13.1 Spiritual, Moral, Ethical, Social, Cultural and Other Issues**
- The study of Design and Technology should contribute substantially to candidates' understanding of moral, ethical, social and cultural issues. Such issues underlie all design and manufacturing activities and are explicitly referred to in Sections 9.1 – 11.14 of the Subject Content. These issues will be tested in both coursework and the written paper.
- 
- 13.2 European Dimension**
- AQA has taken account of the 1988 Resolution of the Council of the European Community in preparing this specification and associated specimen papers.
- 
- 13.3 Environmental Issues**
- AQA has taken account of the 1988 Resolution of the Council of the European Community and the Report “*Environmental Responsibility: An Agenda for Further and Higher Education*” 1993 in preparing this specification and associated specimen papers.
- Environmental considerations are important to the development of all designs and products. Awareness of these issues is specifically required in all sections of the Subject Content and will be tested in both components. See Section 15 for details of coursework requirements.
- 
- 13.4 Citizenship**
- In the Key Stage 4 programme of study for Citizenship, *Developing skills of enquiry and communication* (Section 2) and *Developing skills of participation and responsible action* (Section 3) naturally parallel candidates' actions and approaches during project work. For example, the effects of certain products or manufacturing systems on society and the individual are matters of interest in design and technology, but they also touch on Section 2(a) of the programme of study. Similarly, the designer needs to empathise with the end user (Section 3(a)) and in the process of designing needs to negotiate with clients or during market research to determine and achieve the desired ends (Section 3(b)).
- 
- 13.5 Avoidance of Bias**
- AQA has taken great care in the preparation of this specification and associated specimen papers to avoid bias of any kind.
- 
- 13.6 Health and Safety**
- Health and safety impinges on all aspects of Design and Technology and requires consideration in terms of the maker, the manufacturer, the individual user and society at large. Health and safety and related issues should therefore be an integral part of all teaching. They are expected to be considered in the coursework and will also be tested in the written paper.
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# Centre-Assessed Component

14

## Nature of the Centre-Assessed Component

### 14.1 The nature of Design and Technology

The distinguishing feature of any design and technology course is its practical nature. Knowledge and understanding is not therefore to be acquired purely for its own sake, but in order to satisfy the needs of clients and consumers, and the constraints placed on manufacturers in industrial and commercial contexts.

For Electronic Products candidates will need to be familiar with a range of materials, electronic components and the use of CAD/CAM in production.

Underpinning all learning are the designing and making skills which make use of knowledge and understanding in order to produce outcomes which satisfy a design brief.

#### Designing

Designing is a process based activity involving the progressive engagement with a problem which requires thinking, creating, inventing, predicting, experimenting, decision making, constant evaluation and, where necessary, modification. Designers develop an awareness of the opportunities and constraints placed upon them by taking account of the demands of users and producers, market forces and the effects their products can have on society and the environment.

The activities detailed above draw upon relevant skills and knowledge which are enriched by the application of human values.

#### Making

The realisation of design ideas and solutions to problems is achieved by making products where a range of materials and media may be used. In design and technology, making activities may take many forms, ranging through early experimentation, testing and trials to a final marketable product. All the aspects detailed above provide opportunities for students to develop making skills as they seek to produce high quality outcomes.

## Communication

Communication is an integral aspect of the whole process and it plays three major roles in any design and technology activity.

First, it enables the designer to visualise ideas and thoughts which permit detailed analysis. Second, it provides a record which can be referred to, adapted or refined as the process progresses. Third, it provides an explanation for others of the development of ideas from the mind to the outcome.

The range of communication methods is wide and becoming wider through the increasing use of ICT. All or any should be used *as appropriate to the task in hand* – notes, sketches, formal drawings, photographs, computer programs, oral communication and two or three dimensional representations are all relevant in particular circumstances.

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### 14.2 The Coursework Project (Full and Short Courses)

Candidates are required to submit a single integrated project which consists of a *concise* design folder and/or appropriate ICT evidence and a 3-dimensional outcome. The whole activity should not exceed 40 hours for the Full Course or 20 hours for the Short Course.

GCSE Design and Technology involves increased emphasis on the industrial aspects of designing and making, particularly in the use of CAD/CAM, and on the wider effects of technological activity on society and the environment. These elements should therefore be evident in candidates' projects.

Candidates wishing to work with others may do so. Centres must ensure, however, that candidates select appropriate projects and provide individual and separate evidence of their own ability to design and make a quality product from start to finish.

Candidates need to balance the time spent on developing and making the electronics part of their project against the time required for the casing. It is important to remember that this is an 'Electronic Products' specification and therefore greater emphasis should be given to the electronics. As a guide, the coursework should always be weighted in favour of the electronics. Although no precise figure can be given due to the nature of outcomes across candidates' work, a ratio of 70:30 or 60:40 in favour of electronics should deliver the balance to satisfy the coursework requirements for this specification.

It is expected that candidates will adopt a "systems approach" to designing their circuits and that for the award of the higher grades (A and B) on the Full Course, they will normally produce circuits which have process units built up from at least two basic building blocks.

Candidates may use the Board-set project outlines given in paragraph 15.2 below, formulate their own briefs or use briefs set by the centre. The centre is responsible for ensuring candidates attempt projects which satisfy the coursework requirements (see Section 16 below).

Candidates may enter for any other GCSE specification at the same sitting. However the submission of the same piece of coursework for more than one specification is prohibited.

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### 14.3 The Short Course Project

Quality designing and quality making are requirements for any Design and Technology project. With only 20 hours available for short course projects, however, it becomes particularly important that candidates use their time in the most profitable and effective way. The following advice is given to help teachers and candidates, but teachers will find fuller guidance in the 'Teachers' Guide.

The identification of a suitable task is a crucial factor in managing the short course project. Candidates undertaking short course projects should be guided by teachers to smaller, more focused or less complex problems than might be expected for a full course project. It should be noted, however, that the requirement for *quality* work is the same as for the full course, regardless of the scale of the work. Short course candidates may achieve the higher grades with high quality use of process units made from a single building block circuit.

Candidates may use the Board-set project outlines given in paragraph 15.2 below, formulate their own briefs or use briefs set by the centre. The centre is responsible for ensuring candidates attempt projects which satisfy the coursework requirements (see Section 15 below).

Time management is another important element for successful short course projects. It is recommended that, before the project period begins, teachers provide a time plan for candidates, which allows realistic and proportionate time for the various stages and activities.

Time spent on an initial analysis of the problem will help to reduce or eliminate wasteful, unfocused research. Focused research can in turn reduce the time needed for a careful analysis.

Short course candidates are not expected to generate the same quantity of ideas as full course candidates, although the same level of creative ideas is still expected. The more focused analysis and research should help in producing a workable design solution more quickly.

Making skills represent two-thirds of the project marks and this should have been taken into account in the pre-planning stage. A quality product is still expected, but it does not need to be large or complex to gain high marks. The product does need, however, to include a variety of skills, techniques and/or processes that are completed to a high standard, and which overall satisfy the design objectives.

## Guidance on Setting the Centre-Assessed Component

### 15.1 Project Outlines

Project outlines are given in para 15.2 for Design and Technology (Electronic Products) full and short courses. Centres may use these or adapt them to meet the needs of their candidates. Centres wishing to develop their own outlines for candidates should take note of the following guidelines.

The checklist below is given to help teachers ensure that the project outlines they prepare will meet both the needs of candidates and the requirements of the specification. Prior approval of centre devised project outlines is not required.

- a. Does the outline encourage an integrated approach to designing and making and represent a *level of demand* appropriate to the individual candidate's ability?
- b. Has the outline or problem been so written that candidates will be able to demonstrate the highest level of their ability in each Assessment Objective?
- c. Where a single outline, e.g. design and make a teaching aid, is to be presented to a number of candidates covering a wide ability range, has each candidate produced a brief for him/herself that will be challenging, but not daunting?
- d. Does the project outline offer scope for candidates to consider.
  - the effects and implications of technological activity (e.g. industrial, social, moral, cultural, economic, environmental factors);
  - systems and control;
  - provision for product maintenance;
  - repetition skills (e.g. multiple production);
  - use of CAD/CAM and ICT skills in general;
  - product quality;
  - health and safety in relation to the maker and others?
- e. Are the resources, equipment, tools, materials and media available for the potential demands of the project?
- f. Can the project be completed satisfactorily in 40 hours for the full course or in 20 hours for the short course?

- g. Will the task permit sufficient supervision to enable the teacher to certify that the candidate's work is his/her own?

Where candidates work with others, it must be possible to identify the individual contribution of each candidate, so that the requirements in the specification are met.

- h. Is the project outline free from political, ethnic, gender and other forms of bias?

## 15.2 Project Outlines

The following list of possible projects is provided as a starting point for candidates. Candidates may use these, adapt them or devise their own.

### Full Course

Full course candidates may only achieve the higher grades of A and B with quality use of process units made from more than one building block.

1. design and make an electronic device to select National Lottery numbers;
2. design and make an electronic bicycle theft alarm to fit on the frame of a bicycle;
3. design and make an electronic school bag alarm;
4. design and make an electronic aid to assist a student learning music which has a visual and audio output;
5. design and make an electronic smoke alarm;
6. design and make an electronic device which will assist snooker or darts players when totalling their score;
7. design and make an electronic aid which will help referee quiz nights to determine which team hit the button first;
8. design and make an electronic device to be worn by children walking at night or joggers to make their presence known to motorists;
9. design and make an electronic money box which outputs a reward each time a child inserts a coin;
10. design and make an electronic die to replace a conventional die for use with a board game;
11. design and make an electronic educational toy which is intended to improve a child's:
  - understanding of numbers, or
  - understanding of letters, or
  - understanding of shapes.
12. design and make an electronic system which will indicate to a caravan owner that the gas level in the bottle is getting low.

## Short Course

Short Course candidates may achieve the higher grades of A and B with high quality use of process units made from a single building block circuit. Where possible, they should be encouraged to combine process units.

1. design and make an electronic timer to be used when playing a board game;
2. design and make a flashing light emitting diode display as part of a child's educational toy;
3. design and make an electronic water level detector;
4. design and make an electronic fridge alarm to indicate the door has been left open;
5. design and make an electronic device to indicate the light level to cricket umpires;
6. design and make an electronic device to indicate to a gardener the need to take plants indoors at night;
7. design and make an electronic aid to assist a student learning music;
8. design and make an electronic aid to assist sports people with their training or to improve their skill;
9. design and make an electronic locker alarm or drawer alarm;
10. design and make an electronic flashing "lights on sign" to be positioned next to light switches;
11. design and make an electronic device to be worn at social events such as discos;
12. design and make a fuse tester.

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### 15.3 Support Material

Further examples of project outlines are included in the *Teachers' Guide*. Other material to support teachers will be produced for the annual teachers' meetings in the Autumn Term.

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### 15.4 Coursework Advisers

Coursework Advisers will be available to assist centres with any matters relating to coursework. Details will be provided when AQA knows which centres are following the specification.

## Assessment Criteria

### 16.1 Introduction

Teachers are required to determine grades separately for the designing and making elements of their candidates' coursework. To do this they must use their professional judgement in conjunction with the Assessment Criteria given in 16.3 below.

The level of demand of a design brief should influence the interpretation of the criteria. A successful project which makes great demands on skills, cognitive abilities and breadth and depth of knowledge should be more highly rewarded than a successful project with fewer demanding aspects.

Quality of work is more important than quantity and size. For this reason no estimate of the number of pages in a design folio or of the size and complexity of the product is given. Candidates should, however, plan to produce **concise** design folders and 3D outcomes which can reasonably be completed, in total, in no more than 40 hours for the full course and 20 hours for the short course. Candidates who do not complete their projects will be assessed on what they submit.

Candidates wishing to work with others may do so. Centres must ensure, however, that candidates select appropriate projects and provide individual and separate evidence of their own ability to design and make a quality product from start to finish.

The Assessment Criteria give guidance on the expected levels of achievement in Designing Skills and Making Skills for grades G-A. Teachers should note that A\* does not feature as a coursework grade. A\* grades are determined arithmetically on the total marks gained for the examination and are available only for candidates who have taken a Higher Tier paper.

As in any holistic assessment, a weak performance in one aspect of a candidate's work may be balanced by a strong performance in another. The principle of "best fit" should be applied when using these criteria.

An assessment of the quality of written communication in the design folder is to be made according to the criteria given in 16.4.

Centres are strongly recommended to provide candidates with feedback as their work progresses. This can not only encourage or reward the candidates, but it can also ease the assessment burden on teachers at the end of the coursework period.

Teachers should not record their comment on candidates' work; any written comments should be recorded on the Candidate Record Form.

## 16.2 Assessment Procedure

An assessment of a candidate's coursework should follow the pattern given below.

- a. Guided by the criteria, assess the Designing Skills in terms of a whole grade, e.g. Grade C.
- b. Refine that decision to High (H), Middle (M) or Low (L). A candidate only just achieving the required standard should be given the lowest assessment in the grade, (L), while a candidate just failing to reach the grade above should be given the highest in the grade (H).
- c. Repeat a. and b. above for Making Skills.
- d. Record the refined grade for Designing (e.g. High B = HB) and the refined grade for Making (e.g. Mid E = ME) on page 4 of the Candidate Record Form.
- e. Using the *Project Assessment Matrix* (Appendix D), derive from the two grade decisions a single mark. For example, a High B for Designing and a Mid E for Making will produce a mark of 52.
- f. Record the mark derived from the matrix in the space on page 4.
- g. Using the criteria below, make an overall assessment of candidates' completed design folders for the quality of written communication (QWC) and determine a mark out of a maximum of 5 marks.
- h. Record the QWC mark in the space provided on page 4.
- i. Add together the Matrix mark and the QWC mark and write the total out of 95 in the Total Mark box.
- j. The total mark for each candidate is to be recorded on the AQA mark sheet which will be sent to centres in the Spring Term.



**16.3 Assessment Criteria Candidates will have:**

Grade	Designing	Making
<b>G</b>	<ol style="list-style-type: none"> <li>gathered minimal research information;</li> <li>provided little evidence of analysis of task or research;</li> <li>produced a simple specification;</li> <li>produced a solution, with rudimentary forward planning;</li> <li>attempted a superficial evaluation of the outcome of their work;</li> <li>demonstrated very limited communication, graphical and ICT skills;</li> <li>provided little or no evidence of having considered industrial practices and systems and control.</li> </ol>	<ol style="list-style-type: none"> <li>used materials, components and equipment safely under close supervision;</li> <li>produced references to the use of CAM where appropriate;</li> <li>produced an undemanding or incomplete outcome;</li> <li>some evidence of QA and QC.</li> </ol>
<b>F</b>	<ol style="list-style-type: none"> <li>used more than one source to gather research information;</li> <li>made a limited attempt to analyse the task and the research material;</li> <li>produced a generalised specification;</li> <li>produced at least two proposals which satisfy parts of the specification;</li> <li>used a proposal to produce the outcome with little development and forward planning;</li> <li>superficially tested and evaluated their work against original intentions;</li> <li>demonstrated limited communication, graphical and ICT skills;</li> <li>provided limited evidence of having considered industrial practices and systems and control.</li> </ol>	<ol style="list-style-type: none"> <li>used materials, components and equipment correctly and safely (including CAM if appropriate);</li> <li>produced a largely complete but undemanding outcome;</li> <li>demonstrated accuracy and finish in some parts of the product;</li> <li>produced evidence of some QA and QC.</li> </ol>
<b>E</b>	<ol style="list-style-type: none"> <li>used a limited number of sources to gather research information;</li> <li>made a superficial analysis of the task and most of the research material;</li> <li>produced a specification which reflects the most obvious features of the analysis;</li> <li>produced some proposals which satisfy most of the specification;</li> <li>used their proposals and relevant knowledge to produce a solution which satisfies most of the specification;</li> <li>demonstrated some forward planning;</li> <li>tested and evaluated some aspects of their work;</li> <li>used some appropriate communication, graphical and ICT skills to convey design ideas;</li> <li>provided limited evidence of having considered industrial practices and systems and control.</li> </ol>	<ol style="list-style-type: none"> <li>corrected working errors where necessary;</li> <li>used materials, components, equipment and processes correctly and safely (including CAM if appropriate);</li> <li>produced a largely complete and largely effective outcome;</li> <li>demonstrated a fair degree of accuracy and finish in the overall product;</li> <li>applied QA and QC broadly but superficially.</li> </ol>
<b>D</b>	<ol style="list-style-type: none"> <li>used several appropriate sources to gather relevant research information;</li> <li>made a simple analysis of the task and all research material;</li> <li>produced a specification which reflects most of the analysis;</li> <li>produced several proposals which satisfy the specification;</li> <li>used their proposals and relevant knowledge to develop a solution which satisfies the specification;</li> <li>planned sequence of making activities;</li> <li>tested and evaluated most aspects of their work and made some appropriate modifications;</li> <li>used appropriate communication, graphical and ICT skills to convey design ideas;</li> <li>provided limited evidence of having considered relevant industrial practices and systems and control.</li> </ol>	<ol style="list-style-type: none"> <li>appropriately corrected working errors;</li> <li>used appropriate materials, components, equipment and processes correctly and safely (including CAM);</li> <li>produced an effective and largely complete outcome;</li> <li>demonstrated a reasonable level of accuracy and finish in the product;</li> <li>applied QA and QC broadly.</li> </ol>

**Candidates will have:**

Grade	Designing	Making
<b>C</b>	<ol style="list-style-type: none"> <li>used a variety of appropriate sources to gather and order relevant research information;</li> <li>analysed the task and the research material;</li> <li>produced a specification which reflects the analysis;</li> <li>produced a range of proposals which satisfy the specification;</li> <li>used their proposals and relevant knowledge to develop a detailed design solution which satisfies the specification;</li> <li>planned a largely correct, and workable, sequence of main making activities;</li> <li>tested, evaluated and modified their work throughout the process as appropriate;</li> <li>used a range of communication, graphical and ICT skills sufficient to convey ideas to themselves and others;</li> <li>provided evidence of having considered relevant issues, industrial practices and systems and control.</li> </ol>	<ol style="list-style-type: none"> <li>recognised the need for and justified any changes or adaptations;</li> <li>used appropriate materials, components, tools, equipment and processes (including CAM) correctly and safely;</li> <li>produced a complete, effective and well-assembled outcome;</li> <li>demonstrated a level of accuracy and finish in the product which satisfies most of the demands of the design solution;</li> <li>clearly used QA and QC to control quality in most activities.</li> </ol>
<b>B</b>	<ol style="list-style-type: none"> <li>produced a well ordered and relevant range of appropriate research information;</li> <li>thoroughly analysed the task and research material;</li> <li>produced a detailed specification closely reflecting the analysis;</li> <li>produced a wide range of proposals which satisfy the specification;</li> <li>used their proposals and relevant knowledge of techniques, manufacturing and working characteristics of materials to develop a detailed design solution;</li> <li>planned the correct sequence of making activities;</li> <li>tested, evaluated and modified their work throughout the process as appropriate;</li> <li>used an appropriate range of communication, graphical and ICT skills sufficient to convey ideas to themselves and others effectively;</li> <li>provided evidence of having considered relevant issues, industrial practices and systems and control.</li> </ol>	<ol style="list-style-type: none"> <li>recorded and justified the need for any changes or adaptations;</li> <li>used appropriate materials, components, tools, equipment and processes (including CAM) skilfully, correctly and safely;</li> <li>made a complete, effective and skilfully-produced outcome;</li> <li>demonstrated a level of accuracy and finish in the product which satisfies the demands of the design solution;</li> <li>provided evidence of QA &amp; QC throughout manufacture.</li> </ol>
<b>A</b>	<ol style="list-style-type: none"> <li>used a wide variety of appropriate sources to gather relevant research information;</li> <li>analysed the task and the research material logically, thoroughly and effectively;</li> <li>produced a detailed specification which focuses closely on the analysis;</li> <li>produced a wide range of distinct proposals which satisfy the specification;</li> <li>used one or more of their proposals and relevant knowledge of techniques, manufacturing and working characteristics to develop a detailed and coherent design solution;</li> <li>produced a correct sequence of activities which shows where, why and how practical production decisions were made;</li> <li>tested, objectively evaluated and effectively modified their work throughout the process as appropriate;</li> <li>selected and skilfully used a wide range of communication, graphical and ICT skills which have helped to clarify their thinking and are sufficient to convey ideas to themselves and others effectively and precisely;</li> <li>provided evidence that they have considered and taken account of relevant issues, industrial practices and systems and control.</li> </ol>	<ol style="list-style-type: none"> <li>recorded and justified the need for any changes or adaptations;</li> <li>used appropriate materials, components, equipment and processes (including CAM) consistently correctly, skilfully and safely;</li> <li>made a complete product of high quality;</li> <li>demonstrated an ability to satisfy accurately and completely all the demands of the design solution;</li> <li>thoroughly considered QA &amp; QC and applied them consistently and successfully.</li> </ol>

**16.4 Quality of Written Communication**

An assessment for the quality of written communication shown in the completed design folder is to be made separately from the designing grade. Use the criteria given below and record the mark on the Candidate Record Form.

**Marks**

- 4-5 Information is clearly and logically presented using an appropriate form. The text is legible. Candidates spell, punctuate and use the rules of grammar accurately, enabling the meaning to be clearly understood.
- 2-3 Information is presented in an appropriate form. The text is legible. Candidates generally spell, punctuate and use the rules of grammar accurately, although there may be some errors. The meaning is clear.
- 1 Some of the information presented is in an appropriate form. Generally the text is legible. Although there are errors in spelling, punctuation and grammar, candidates' meaning can be understood.
- 0 Candidates have failed to reach the standard required for the award of a mark.

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**16.5 Evidence to Support the Award of Marks**

Teachers should keep records of their assessments during the course, in a form which facilitates the complete and accurate submission of the final assessments at the end of the course.

When the assessments are complete, the grades and/or marks awarded under each of the assessment criteria must be entered on the Candidate Record Form, with supporting information given in the spaces provided. A specimen Candidate Record Form appears in Appendix B; the exact design may be modified before the operational version is issued and the correct year's Candidate Record Forms should always be used.

## Supervision and Authentication

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- 17.1 Supervision of Candidates' Work** Candidates' work for assessment must be undertaken under conditions which allow the teacher to supervise the work and enable the work to be authenticated. If it is necessary for some assessed work to be done outside the centre, sufficient work must take place under direct supervision to allow the teacher to authenticate each candidate's whole work with confidence.
- 
- 17.2 Guidance by the Teacher** The work assessed must be solely that of the candidate concerned.
- The Coursework Project is, however, as much a vehicle for teaching as for assessment. It is therefore expected that the teacher will need to give advice and assistance to individual candidates as part of normal teaching. This should be provided, but normally in such a way that candidates have alternative possibilities to explore, and their own decisions to make about accepting or using the information or advice provided by the teacher. There may, of course, be occasions when direct teacher intervention is necessary to ensure safety, to prevent costly waste of materials or to provide a less able candidate with positive assistance.
- In any case where assistance given to an individual candidate goes beyond normal teaching, details must be recorded on the Candidate Record Form and taken into account in the assessment of coursework.
- 
- 17.3 Unfair Practice** At the start of the course, the supervising teacher is responsible for informing candidates of the AQA Regulations concerning malpractice. Candidates must not take part in any unfair practice in the preparation of coursework to be submitted for assessment, and must understand that to present material copied directly from books or other sources without acknowledgement will be regarded as deliberate deception. Centres must report suspected malpractice to AQA. The penalties for malpractice are set out in the AQA Regulations.
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- 17.4 Authentication of Candidates' Work** Both the candidate and the teacher are required to sign declarations confirming that the work submitted for assessment is the candidate's own. The teacher declares that the work was conducted under the specified conditions, and records details of any additional assistance.

## Standardisation

### 18.1 Standardising Meetings

Annual standardising meetings will usually be held in the autumn term. Centres entering candidates for the first time must send a representative to the meetings. Attendance is also mandatory in the following cases:

- where there has been a serious misinterpretation of the specification requirements;
- where the nature of coursework tasks set by a centre has been inappropriate;
- where a significant adjustment has been made to a centre's marks in the previous year's examination.

After the first year, attendance is at the discretion of centres. At these meetings support will be provided for centres in the development of appropriate coursework tasks and assessment procedures.

### 18.2 Internal Standardisation of Marking

The centre is required to standardise the assessments across different teachers and teaching groups to ensure that all candidates at the centre have been judged against the same standards. If two or more teachers are involved in marking a component, one teacher must be designated as responsible for internal standardisation. Common pieces of work must be marked on a trial basis and differences between assessments discussed at a training session in which all teachers involved must participate. The teacher responsible for standardising the marking must ensure that the training includes the use of reference and archive materials such as work from a previous year or examples provided by AQA. The centre is required to send to the moderator the Centre Declaration Sheet, duly signed, to confirm that the marking of centre-assessed work at the centre has been standardised. If only one teacher has undertaken the marking, that person must sign this form.

A specimen Centre Declaration Sheet appears in Appendix B.

## Administrative Procedures

### 19.1 Recording Assessments

The candidates' work must be marked according to the assessment criteria set out in paragraphs 16.3 and 16.4. The marks and supporting information must be recorded in accordance with the instructions in paragraph 16.5. The completed Candidate Record Form for each candidate must be attached to the work and made available to AQA on request.

At the beginning of the course, centres are required to inform the AQA of the approximate number of candidates to be entered for the examination so that the appropriate number of Candidate Record Forms may be sent.

### 19.2 Submitting Marks and Sample Work for Moderation

The total component mark for each candidate must be submitted to AQA on the mark sheets provided or by Electronic Data Interchange (EDI) by the specified date. Centres will be informed which candidates' work is required in the samples to be submitted to the moderator.

### 19.3 Factors Affecting Individual Candidates

Teachers should be able to accommodate the occasional absence of candidates by ensuring that the opportunity is given for them to make up missed assessments.

Special consideration should be requested for candidates whose work has been affected by illness or other exceptional circumstances. Information about the procedure is issued separately.

If work is lost, AQA should be notified immediately of the date of the loss, how it occurred, and who was responsible for the loss. AQA will advise on the procedures to be followed in such cases.

Where special help which goes beyond normal learning support is given, AQA must be informed so that such help can be taken into account when assessment and moderation take place.

Candidates who move from one centre to another during the course sometimes present a problem for a scheme of internal assessment. Possible courses of action depend on the stage at which the move takes place. If the move occurs early in the course the new centre should take responsibility for assessment. If it occurs late in the course it may be possible to accept the assessments made at the previous centre. Centres should contact AQA at the earliest possible stage for advice about appropriate arrangements in individual cases.

#### 19.4 Retaining Evidence and Re-Using Marks

The centre must retain the work of all candidates, with Candidate Record Form attached, under secure conditions, from the time it is assessed, to allow for the possibility of an enquiry upon results. The work may be returned to candidates after the issue of results provided that no enquiry upon result is to be made which will include re-moderation of the coursework component. If an enquiry upon result is to be made, the work must remain under secure conditions until requested by AQA.

Candidates re-taking the examination may carry forward their moderated coursework marks. These marks have a shelf-life which is limited only by the shelf-life of the specification, and they may be carried forward an unlimited number of times within this shelf-life.

## 20

## Moderation

#### 20.1 Moderation Procedures

Moderation of the coursework is by inspection of a sample of candidates' work. This will initially involve design folders for the sample being sent by post from the centre to the moderator appointed by AQA. Moderators will visit new centres to assess the practical outcomes. They will also visit other centres as needs dictate. The centre marks must be submitted to AQA and the sample of design folders must reach the moderator by the specified date in the year in which the qualification is awarded.

Following the re-marking of the sample work, the moderator's marks are compared with the centre marks to determine whether any adjustment is needed in order to bring the centre's assessments into line with standards generally. In some cases it may be necessary for the moderator to call for the work of other candidates. In order to meet this possible request, centres must have available the coursework and Candidate Record Form of every candidate entered for the examination and be prepared to submit it on demand. Mark adjustments will normally preserve the centre's order of merit, but where major discrepancies are found, AQA reserves the right to alter the order of merit.

#### 20.2 Post-Moderation Procedures

On publication of the GCSE results, the centre is supplied with details of the final marks for the coursework component.

The candidates' work is returned to the centre after the examination with a report form from the moderator giving feedback to the centre on the appropriateness of the tasks set, the accuracy of the assessments made, and the reasons for any adjustments to the marks.

Some candidates' work may be retained by AQA for archive purposes.



## Awarding and Reporting

### 21 Grading, Shelf-Life and Re-Sits

- 21.1 Qualification Titles** The qualifications based on this specification have the following titles: AQA General Certificate of Secondary Education in Design and Technology (Electronic Products); AQA General Certificate of Secondary Education in Design and Technology (Electronic Products) (Short Course).
- 21.2 Grading System** Both the full course and short course qualifications will be graded on an 8 point grade Scale A\*, A, B, C, D, E, F, G. Candidates who fail to reach the minimum standard for grade G will be recorded as U (unclassified) and will not receive a qualification certificate.
- Candidates must be entered for either the Foundation Tier or Higher Tier. For candidates entered for the Foundation Tier, grades C–G are available. For candidates entered for the Higher Tier A\*–D are available. There is a safety net for candidates entered for the Higher Tier, where an allowed Grade E will be awarded where candidates just fail to achieve Grade D. Candidates who fail to achieve a Grade E on the Higher Tier or Grade G on the Foundation Tier will be reported as unclassified.
- 21.3 Re-Sits** Individual components may not be retaken, but candidates may retake the whole qualification more than once.
- 21.4 Minimum Requirements** Candidates will be graded on the basis of work submitted for assessment.
- 21.5 Carrying Forward of Centre-Assessed Marks** Candidates re-taking the examination may carry forward their moderated coursework marks. These marks have a shelf-life which is limited only by the shelf-life of the specification, and they may be carried forward an unlimited number of times within this shelf-life.
- 21.6 Awarding and Reporting** The regulatory authorities, in consultation with GCSE awarding bodies, developed a Code of Practice for GCSE qualifications which were introduced in September 2000. This specification complies with the grading, awarding and certification requirements of the current GCSE, GCE and AEA Code of Practice April 2008 and will be revised in the light of any subsequent changes for future years.



# Appendices

## A

### Grade Descriptions

The following grade descriptors indicate the level of attainment characteristic of the given grade at GCSE. They give a general indication of the required learning outcomes at each specific grade. The descriptors should be interpreted in relation to the content outlined in the specification; they are not designed to define that content.

The grade awarded will depend in practice upon the extent to which the candidate has met the assessment objectives (as in section 6) overall. Shortcomings in some aspects of the examination may be balanced by better performances in others.

**Grade F** When designing and making products, and acquiring and applying knowledge, skills and understanding, candidates draw on and use various sources of information. They clarify their ideas through discussion, drawing and modelling; use their understanding of the characteristics of familiar products when developing and communicating their own ideas and work from their own plans, modifying them where appropriate.

Candidates work with a range of tools, materials, equipment, components and processes with some precision; check their work as it develops and modify their approach in the light of progress; test and evaluate their products, showing that they understand the situations in which their designs will have to function and are aware of resources as a constraint and evaluate their use of basic information sources.

**Grade C** When designing and making products, and acquiring and applying knowledge, skills and understanding, candidates use a wide range of appropriate sources of information and strategies to develop ideas, responding to information they have identified. They investigate form, function and production processes and communicate ideas, using appropriate media.

Candidates recognise the needs of users and develop realistic designs. They produce plans that make use of time and resources to carry out the main stages of making products. They work with a range of tools, materials, equipment, components and processes, taking account of their characteristics, and organise their work so that they can carry out processes accurately and consistently, and use tools, equipment, materials and components with precision.

Candidates adapt their methods of manufacture to changing circumstances, providing a sound explanation for any change from the initial specification. They select appropriate techniques to test and evaluate how their products would perform when used and modify their products in the light of ongoing evaluation to improve their performance. They evaluate their use of information sources.

**Grade A** When designing and making products, and acquiring and applying knowledge, skills and understanding, candidates seek out and use information to help their detailed design thinking, and recognise the needs of a variety of client groups. They are discriminating in their selection and use of information sources to support their work and they use a wide range of strategies to develop appropriate ideas, responding to information they have identified.

Candidates investigate form, function and production processes and communicate ideas using a variety of appropriate media. They recognise the different needs of a range of users when developing fully realistic designs. When planning, they make sound decisions on materials and techniques based on their understanding of the physical properties and working characteristics of materials. They work from formal plans that make the best use of time and resources; work with a range of tools, equipment, materials and components to a high degree of precision and make products that are reliable and robust and that fully meet the quality requirements given in the design proposal.

Candidates identify conflicting demands on their design, explain how their ideas address these demands and use this analysis to produce proposals. They identify a broad range of criteria for evaluating and testing their products, clearly relating their findings to the purpose for which the products were designed and the appropriate use of resources, and fully evaluate their use of information sources.

**B**

## Record Forms

**Centre Declaration Sheets** and **Candidate Record Forms** are available on the AQA website in the Administration area.

They can be accessed [via the following link](#)

C

## Overlaps with other Qualifications

Some overlaps exist between this and other Design and Technology specifications. The overlap is primarily in the design process and the scheme of assessment. As all specifications conform to the GCSE Design and Technology Subject Criteria, there are also overlaps of broad content, e.g. ICT, health and safety, systems and control, industrial and commercial practice, but each is dealt with in the context of the focus areas embodied in the specification title.

D

# Project Assessment Matrix

DESIGN & TECHNOLOGY PROJECT ASSESSMENT MATRIX

DESIGNING SKILLS

	A			B			C			D			E			F			G			U																													
	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L																											
A	89	88	84	86	85	84	82	81	80	77	76	74	74	73	72	70	69	68	66	65	64	66	65	64	62	61	60	62	61	60	58	57	56	54	53	52	51	50	49	48											
B	87	86	82	84	83	82	80	79	78	75	74	72	72	71	70	68	67	66	64	63	62	60	59	58	56	55	54	52	51	50	48	47	46	44	43	42	41	40	39	38											
C	85	84	80	82	81	78	78	77	76	74	73	72	70	69	68	66	65	64	62	61	60	58	57	56	54	53	52	50	49	48	46	45	44	42	41	40	38	37	36	34	33	32									
D	81	80	76	78	77	76	74	73	72	70	69	68	66	65	64	62	61	60	58	57	56	54	53	52	50	49	48	46	45	44	42	41	40	38	37	36	34	33	32	30	29	28	26	25	24						
E	79	78	74	76	75	74	72	71	70	68	67	66	64	63	62	60	59	58	56	55	54	52	51	50	48	47	46	44	43	42	40	39	38	36	35	34	32	31	30	28	27	26	25	24	23	22					
F	77	76	72	74	73	72	70	69	68	66	65	64	62	61	60	58	57	56	54	53	52	50	49	48	46	45	44	42	41	40	38	37	36	34	33	32	30	29	28	26	25	24	22	21	20	18	17	16			
G	81	80	76	78	77	76	74	73	72	70	69	68	66	65	64	62	61	60	58	57	56	54	53	52	50	49	48	46	45	44	42	41	40	38	37	36	34	33	32	30	29	28	26	25	24	22	21	20	18	17	16
U	80	79	74	76	75	74	72	71	70	68	67	66	64	63	62	60	59	58	56	55	54	52	51	50	48	47	46	44	43	42	40	39	38	36	35	34	32	31	30	28	27	26	25	24	23	22					
	78	77	76	74	73	72	70	69	68	66	65	64	62	61	60	58	57	56	54	53	52	50	49	48	46	45	44	42	41	40	38	37	36	34	33	32	30	29	28	26	25	24	22	21	20	18	17	16			
	74	73	72	70	69	68	66	65	64	62	61	60	58	57	56	54	53	52	50	49	48	46	45	44	42	41	40	38	37	36	34	33	32	30	29	28	26	25	24	22	21	20	18	17	16						
	72	71	70	68	67	66	64	63	62	60	59	58	56	55	54	52	51	50	48	47	46	44	43	42	40	39	38	36	35	34	32	31	30	28	27	26	25	24	23	22	20	19	18	16	15	14	12	11	10		
	70	69	68	66	65	64	62	61	60	58	57	56	54	53	52	50	49	48	46	45	44	42	41	40	38	37	36	34	33	32	30	29	28	26	25	24	22	21	20	18	17	16	14	13	12	10	9	8			
	66	65	64	62	61	60	58	57	56	54	53	52	50	49	48	46	45	44	42	41	40	38	37	36	34	33	32	30	29	28	26	25	24	22	21	20	18	17	16	14	13	12	10	9	8						
	64	63	62	60	59	58	56	55	54	52	51	50	48	47	46	44	43	42	40	39	38	36	35	34	32	31	30	28	27	26	25	24	23	22	20	19	18	16	15	14	12	11	10	8	7	6	5	4	3	2	
	62	61	60	58	57	56	54	53	52	50	49	48	46	45	44	42	41	40	38	37	36	34	33	32	30	29	28	26	25	24	22	21	20	18	17	16	14	13	12	10	9	8	6	5	4	3	2	1	0		
	58	57	56	54	53	52	50	49	48	46	45	44	42	41	40	38	37	36	34	33	32	30	29	28	26	25	24	22	21	20	18	17	16	14	13	12	10	9	8	6	5	4	3	2	1	0					
	56	55	54	52	51	50	48	47	46	44	43	42	40	39	38	36	35	34	32	31	30	28	27	26	25	24	23	22	20	19	18	16	15	14	12	11	10	8	7	6	5	4	3	2							
	54	53	52	50	49	48	46	45	44	42	41	40	38	37	36	34	33	32	30	29	28	26	25	24	22	21	20	18	17	16	14	13	12	10	9	8	6	5	4	3	2	1	0								
	50	49	48	46	45	44	42	41	40	38	37	36	34	33	32	30	29	28	26	25	24	22	21	20	18	17	16	14	13	12	10	9	8	6	5	4	3	2	1	0											
	48	47	46	44	43	42	40	39	38	36	35	34	32	31	30	28	27	26	24	23	22	20	19	18	16	15	14	12	11	10	8	7	6	5	4	3	2	1	0												
	46	45	44	42	41	40	38	37	36	34	33	32	30	29	28	26	25	24	22	21	20	18	17	16	14	13	12	10	9	8	6	5	4	3	2	1	0														
	42	41	40	38	37	36	34	33	32	30	29	28	26	25	24	22	21	20	18	17	16	14	13	12	10	9	8	6	5	4	3	2	1	0																	
	40	39	38	36	35	34	32	31	30	28	27	26	24	23	22	20	19	18	16	15	14	12	11	10	8	7	6	5	4	3	2	1	0																		
	38	37	36	34	33	32	30	29	28	26	25	24	22	21	20	18	17	16	14	13	12	10	9	8	6	5	4	3	2	1	0																				
	34	33	32	30	29	28	26	25	24	22	21	20	18	17	16	14	13	12	10	9	8	6	5	4	3	2	1	0																							
	32	31	30	28	27	26	24	23	22	20	19	18	16	15	14	12	11	10	8	7	6	5	4	3	2	1	0																								
	30	29	28	26	25	24	22	21	20	18	17	16	14	13	12	10	9	8	6	5	4	3	2	1	0																										

M A K I N G S K I L L S