GCSE 2003

June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Report on the Examination

Design and Technology
Electronic Products

- Full Course
- Short Course

GCSE - (3541/3551)

CONTENTS

Design and Technology: Electronic Products

Examination Papers

Full Course

Tier F

General

This paper was very accessible to candidates with good responses evident. Centres that had taught the knowledge and skills through the coursework scored well. One example of this is bread boarding which is a practical element applied to circuit design and testing. Many candidates struggled or had no comprehension of this technique, but candidates that did, scored well on that question.

Throughout the paper there was the opportunity to develop the first part of an answer by including a reason. Candidates need to show an understanding of components and their function. They should be aware of the marks available for each question and then tailor their answers to gain maximum marks. A simple response to a three mark question will result in only one mark.

Question One

The majority of candidates scored half marks on this question.

(a) Most candidates answered correctly.

(b) (i) Most candidates had the correct answer.

(ii) This was mostly well answered with the Series Resistor formula.

(c) Very few candidates displayed an appreciation of the 5% tolerance.

Question Two

Many candidates did struggle with simple component identification.

(a) (i) Most candidates wrote Process, but fewer named the Thermistor.

(ii) Very few candidates answered with the Open Loop.

(b) (i) Most candidates answered with potentiometer, but some did label it a resistor.

(ii) Badly answered. Many candidates wrote transistor.

(iii) Badly answered. Many candidates wrote LDR.

(iv) Many candidates answered correctly with Relay.

(v) There was some confusion between Diode and LED.

(c) (i) Most candidates knew the two components involved.

(ii) Few candidates were able to explain, most guessed at the answer.

(iii) Most candidates knew about adjustment, but few commented on sensitivity.

(iv) Again few candidates had an understanding.

(v) Badly answered. Many candidates did not know the voltage.

(d) Most candidates did score some marks for partly answered solutions. Not many candidates used the pole of the relay as a connection. Few scored full marks.

Question Three

This question was well answered by those candidates who had personal experience, through project work, of bread boarding.

(a) Most candidates knew that it was an Astable circuit.

(b) Many candidates labelled the correct pin.

(c) Many candidates correctly named the Capacitor.

(d) (i) Most candidates had an appreciation of a protecting resistor but mostly failed to link protection and too much current.

(ii) Badly answered. Many candidates failed to show the correct working.

(e) This question was either well or badly answered dependant upon practical experience. Many candidates were still placing links in the same hole as components.

Question Four

The logic symbols were identified well, but many candidates failed to complete the truth table correctly.

(a) (i) Most candidates named the gates correctly.

(ii) Few answered correctly, many guessed.

(b) Many candidates gained at least 2 marks with the logic diagram. A significant number scored full marks.

(c) Most candidates had an appreciation of PICs.

(d) A well answered question. Many candidates scored full marks.

Question Five

This question gave many candidates problems. Explanations were brief and displayed little background knowledge.

(a) (i) Most candidates correctly named the LDR. Some did name it a Transistor.

(ii) Many candidates correctly named the potentiometer.

(iii) Fewer candidates correctly identified the Op Amp and gave a valid reason for its inclusion in the circuit.

(b) (i) Most candidates were able to give an advantage for using simulation software.

(ii) Many candidates had an appreciation of CAD in relation to designing a PCB. Some candidates were confused and repeated themselves about the simulation software from the previous question.

(c) (i) Not well answered. Many candidates could not transpose the schematic diagram into a PCB design. This is a common activity throughout the Electronic Products course.

(ii) Not well answered, but better than (i)

(iii) Not well answered.

(iv) Not well answered, but a significant number of candidates did correctly draw in the track.

(d) Many candidates did relate their practical experiences to suitable answers on quality soldering.

(e) Many candidates correctly identified two hazards and suitable precautions to take. Some candidates did not go for the obvious hazards and lost marks for poor responses that related to examples of poor practice.

Question Six

The design sections of this question elicited good answers from the majority of candidates who were able to relate their answers to their project work.

(a) Most candidates successfully identified design considerations in relation to young children.

(b) Some candidates did repeat responses from (a) and lost marks. Many correctly identified suitable areas for research, but a significant number did respond with specifications.

(c) (i) There are still a number of candidates referring to generic materials rather than specific. Many candidates answered well with reasoning associated with the properties of the chosen material.

(ii) Many candidates failed to show how the casing should be constructed and copied the diagram from Figure 13. Few candidates understood the need for housing the blocks for example in a vacuum formed case and mentioning draft angles. Most candidates scored one mark for quality of drawing. A 3D sketch usually gained the full two marks.

(iii) This was generally well answered. Most candidates referred to their practical experiences of securing circuit boards. Quality of drawing for two marks was a well-labelled, clear diagram.

(d) (i) Many candidates were able to draw the buzzer correctly for one mark. Fewer correctly positioned it in the circuit diagram. Some candidates were confused and drew the symbol for a bell.

(ii) Most candidates successfully named two sensors that would be suitable. There were a small number that named sensors found in industrial / home alarm systems that would not have proved suitable.

(e) Most candidates were able to identify two valid reasons for using batch production.

(f) (i) Many candidates could identify the advantages for employers. The most popular answer was reducing the workforce.

(ii) Many candidates correctly identified advantages linked to quality, but some did start to repeat themselves from the previous responses.

(g) The majority of candidates answered with a suitable test, usually involving a child, followed by some form of evaluation.

Question Seven

Most candidates attempted this question. Many repeated themselves over several responses and a few used the same answer to cover all three areas. It was not enough just to write the key words in the appropriate box, these had to be justified in the context of manufacturing, final product and end of use.

Tier H

General

The paper was accessible to a high percentage of candidates. There were very few instances of scripts with questions or parts of questions being unanswered.

Candidates answered the questions on CAD, CAM, PICs and Computer simulation in a confident manner. It would appear that the subject support material had been well used by centres when preparing the candidates.

Some common areas that require improvement are:
- lack of qualification when answering a question that requires a written response
- using equations correctly
- the lack of quality and detail when sketching or drawing.

Question One

(a) (i) Using the colour code caused few problems for most candidates.

(ii) Most candidates referred to the tolerance of the resistor but many failed to provide the additional +/- 5%.

(b) (i) It was surprising that so few answers were completely correct. A common error was using the same 'hole' where the resistor was connected to connect the joining wire.

(ii) Most candidates were able to state advantages of using breadboards.

(iii) Most candidates were able to use the formula but many had difficulty in completing the mathematical part and came up with the value of 18K.

(c) (i) Few candidates were able to articulate the meaning of 'preferred value'.

(ii) Very few answered the question correctly although some credit was given if the value chosen had some reference to the answer given in (b)(iii).

Question Two

(a) Well known.

(b) Generally well answered.

(c) Some confusion was noted when candidates used the 0.1μF value in the equation and had difficulty in placing the decimal point to perform the calculation.

(d) Generally well answered, the most common errors were to join the wire connectors into the same 'hole' on the board or to use the +V battery snap wire connection as the +V supply for the circuit.

(e) (i) Well answered by many.

(ii) The majority of candidates scored well.

(f) Answered well by most candidates and it was clear that most centres had used the training material well.

(g) Most candidates gave the correct sequence when using a PIC.

Question Three

(a) Most candidates had a clear understanding of the advantages of using computer simulation, although some candidates failed to provide sufficient qualification or detail to gain full marks.

(b) Not answered well by the majority of candidates. Most were able to provide a +V supply only.

(c) (i) Most candidates were able to provide a potential divider but many were unable to give the additional resistor a 10K value.

(ii) A surprising number of candidates were unable to add the correct symbol for an LDR.

(iii) This question was quite well done but several candidates misused the equation and worked out V1 instead.

(d) (i) Many wrong answers with the reference potential divider connected to pin 3 rather than pin 2.

(ii) Very few candidates were able to make the relay latch.

(e) The understanding of how an operational amplifier functions remains a stumbling block for all but the higher ability candidates. Most candidates were even unable to comment on the reasons for the two potential dividers being in the circuit.

(f) Generally well answered.

(g) Well answered by the more able candidates but some missed full marks due to not following the circuit more carefully.

Question Four

(a) Good responses were given by most candidates.

(b) Some candidates responded with basic answers while the majority produced detailed research needs. The information that one might gain from anthropometric data was not well known.

(c) (i) The use of the generic ‘plastic’ and ‘wood’ was far too common and very disappointing. The accompanying reasons of ‘strong’ and ‘cheap’ were all too common and indicated a lack of awareness of the materials given in the specification.

(ii) The drawing and sketching skills were of a limited quality. Few candidates included construction detail that was related to a material or process. Some gained credit with the annotation used.

(iii) The quality of sketching again proved to be a major weakness and often did not show the PCB being held in place. Side view/sectional drawings should be encouraged for this type of response as most candidates attempting 3D sketches struggled to produce clear drawings.

(d) (i) Most candidates were able to identify suitable sensors/switches.

(ii) The quality of response to this question was disappointing. The quality of sketching was poor and few candidates showed the sensor/switch 'located in the case' and failed to take into account the thickness of the material that the case was made from.

(e) This question proved to be a good differentiator. Many candidates were able to link the switches to the inputs of the AND gates, some were able to link outputs from the gates to other inputs and the more able candidate linked all together to produce the required output.

Question Five

(a) (i) & (ii) Most candidates had a good grasp of the benefits that the use of CAM has for both Manufacturers and Consumers although some of the less successful candidates often failed to qualify their responses.

(iii) Most candidates were able to link the employment issue with CAM requiring less workers; the more successful candidates also included the need for a more educated workforce as the manual jobs dried up.

(b) The majority of candidates scored well here and appeared to have a sound grasp of the environmental issues involved. Very few candidates failed to gain some marks with the lower achievers' responses being based on general manufacturing issues rather than the environmental issues that the manufacturer faced.

Short Course

Tier F

General

The examiners reported that the depth of knowledge and understanding of basic electronics was about the same as last year, with the majority of candidates demonstrating a good grasp of the **basics** of the subject.

It was again pleasing to note that the majority of candidates were willing to attempt to respond to all the questions, and there were relatively few un-answered or un-attempted questions. Although the paper contained a number of questions that required a written answer, candidates generally responded well, although a significant number found it difficult to express their thoughts and understanding in a clear and coherent way.

Candidates seem to have been better prepared in tackling calculation questions, as many candidates followed the instructions to write the formula, show their workings, and state the units in their answers.

Candidates appear to have been using CAD/CAM, PCB design software and circuit simulation software to a greater extent this year, as a large number of candidates demonstrated their knowledge of such approaches in the questions relating to the advantages of using this software.

Question 3(c) was poorly answered, with few candidates showing an understanding of the finer points of the potential divider.

Question 4, the design-based question, was a particularly good question for the majority of candidates. The identification of design considerations was well answered, with candidates giving clear reasons for their choices. Most candidates described the vacuum-forming process as their choice for the construction method, and did quite well in describing the process using sketches, although the quality of notes was a little disappointing. It was also pleasing to note that the majority of candidates now know about appropriate methods of securing a PCB, with most referring to PCB pillars, or using screws and some sort of support, rather than using glue-guns or 'jamming' a PCB into a box.

Question One

(a) Almost all recognised a series combination.

(b) (i) Most candidates scored well here, although some forgot the units.

(ii) It was pleasing to see most candidates wrote the formula, and showed working etc. Very few candidates seemed to understand the concept of resistor tolerance, with the majority writing about how much heat, power, current etc a resistor could tolerate.

Question Two

(a) The majority scored quite well, with candidates referring to relevant advantages, and giving qualifying reasons.

(b) A surprisingly high number did not recognise an astable circuit.

(c) Well answered.

(d) (i) Most knew that R3 was preventing the LED being damaged, or 'blown-up', but few made reference to too much current.

(ii) Most candidates selected the correct formula and picked-up marks for having a go, although few obtained a complete solution.

(e) A high scoring question.

(f) Generally well answered, although some candidates gave vague, one-word answers like 'easy', or 'simple'.

(g) Most candidates did well here, with the majority making a very good attempt. Few short circuits were seen.

(h) (i) Too many non-specific answers such as wood or plastic were given here.

(ii) Candidates generally scored well, except that many thought that rounded corners and edges were a safety factor.

Question Three

(a) (i) Generally well answered.

(ii) Virtually no candidate responded correctly to this question.

(b) Candidates scored well on this section, having simply learned to recognise the symbols.

(c) (i) Generally well answered.

(ii) Few knew that the resistance drops.

(iii) Very few candidates understood the purpose of the potentiometer.

(iv) Again, not very well answered.

(v) A poor response.

(d) Many candidates scored by connecting the heater to V, and the heater to the relay, but very few connected V to the relay.

(e) (i) Clearly, some centres had taught candidates about PIC technology, and the level of responses was good, but in some centres, the candidates seemed to have no knowledge of PICs.

(ii) Most candidates scored well here, with the vast majority scoring at least 2 marks.

Question Four

(a) Very well answered, with candidates identifying factors and giving good reasons.

(b) Generally well answered, but some candidates found it difficult to express themselves clearly, particularly when trying to give reasons.

(c) (i) Again, some candidates gave non-specific materials, but did give clear reasons for their choice.

(ii) Most candidates described the vacuum forming process using sketches and some notes. The quality of sketching was generally fair, particularly as there was not much space available. Some candidates, however, simply re-designed the case, yet gave no constructional details, having not read the question correctly.

(iii) A majority of candidates made clear reference to PCB pillars, screws etc and sketched their ideas well.

(d) (i) Most candidates drew their response in parallel to the LED, but a high number did not know the correct symbol for a buzzer.

(ii) A good level of response, with candidates giving a very wide range of possible sensors.

(e) Candidates clearly had some knowledge of CAM, and gave reasonable responses, but many gave very brief or one word answers with little or no qualification.

(f) The majority scored well here, but candidates again had difficulty in expressing themselves clearly.

Question Five

Candidates scored well on this question, with most demonstrating a degree of understanding of environmental issues. Although there were some one-word answers, and some repetition, candidates generally did well, and knew about re-cycling and workers' conditions particularly well.

Tier H

General

The examination provided opportunity for all candidates to demonstrate their Design and Technology ability. Most candidates attempted all of the questions, a distinct improvement over previous papers. Calculations and units still pose the biggest stumbling block.

Question One

(a) (i) Well answered with most candidates scoring well.

(ii) Most responded with tolerance but a significant number of candidates did not expand this.

(b) Most candidates scored well in both parts; a significant number had difficulty calculating 5% of their resistance value.

(c) (i) Many alternative correct answers seen. Unfortunately quite a few candidates drew the resistor so there was no connection.

(ii) Generally well answered.

(iii) Many candidates scored full marks; some were confused by the different units.

Question Two

(a) Candidates responded well, with few unqualified answers.

(b) Whilst most candidates selected the correct formula only a minority were able to use the correct units or values to obtain the correct solution. Many failed to use the correct unit for frequency.

(c) Too many responses were unqualified. Only a minority seemed aware of component spacing being correct, therefore making manufacture easier, or of links to CAM.

(d) The majority of candidates responded very well.

(e) Few totally correct solutions seen, although most candidates scored more than half marks for this part. It was disappointing that so many candidates failed to use dots to indicate the junctions between lines in the diagram.

(f) Well answered, though far too many candidates responded with an unqualified "cheaper".

(g) Well answered with the majority of candidates gaining full marks.

QuestionThree

It was disappointing that so few candidates had a good understanding of such a basic circuit and of why a relay is used.

(a) Very few totally correct solutions with few connections to the common terminal shown. Many candidates had drawn too many lines, often connecting the two parts of the circuit together.

(b) (i) Many good answers, but a significant number of candidates were unable to identify the transistor correctly.

(ii) Many candidates described what a diode does rather than its function in this circuit.

(c) Overall this was rather poorly attempted. Many candidates had problems with component identification and then with the resistance change for the thermistor as the temperature fell.

Question Four

(a) Well answered with few unqualified responses.

(b) Generally well answered although many candidates were unaware of what "Anthropometric Data" referred to.

(c) (i) A disappointing number of candidates used the generic material rather than the specific name of one. Reasons were usually valid ones.

(ii) Many candidates just re-drew the product and failed to show how it would be constructed as required by the question.

(iii) The majority of candidates answered this well, with only a few using inappropriate methods.

(d) (i) Well answered.

(ii) Most candidates showed where it would be located rather than how. Many of those who attempted the question correctly failed to show the thickness of the material of the case.

(iii) A wide variety of responses gained credit.

Question Five

Most candidates gained high marks on this question with a wide range of responses.

Coursework

Full Course

The Design and Technology: Electronic Products specification is an electronics design and make course with the emphasis on product design, using appropriate materials to package the electronics. Coursework consists of a project that demonstrates the candidate's ability to undertake an extended design and make activity which integrates the use of electronics and constructional materials in the creation of an electronic product. The coursework project should not exceed 40 hours for the Full Course.

In a number of centres, it was apparent that candidates had spent a higher number of hours working on their coursework than stated by AQA. Centres need to make candidates aware of the suggested timescale when working on their coursework.

As 60% of the examination marks are allocated to the coursework, it is essential that projects reflect good practice and candidates are encouraged to stretch themselves to produce high quality designs and electronic product outcomes. Centres are reminded that 40% of the examination marks are allocated for the realisation of the project and projects should be made to the highest quality the candidate is capable of producing. The design folder represents 20% of the total examination marks and design folders should demonstrate the progress of a candidate's thinking through the use of a range of communication skills. Bulky folders filled with irrelevant material are both wasteful and counterproductive. The key word with design folders is *quality*, not quantity, and candidates need to be made aware of the assessment stages expected within a folder. Equally, centres need to make sure that their candidates are aware that the realisation is worth twice as many marks as the design folder. Far too often, an incomplete realisation can be found alongside an over-elaborate design folder which has taken most of the coursework time to complete.

All of the centres which were involved in the moderation process of Electronic Products this year are to be congratulated on the excellent way the coursework was presented for moderation and thanked for the hospitality extended to the AQA moderating team. Many of the centres had spent a considerable amount of time and effort on the presentation of the coursework for moderation. A number of centres demonstrated the operation of the projects prior to the commencement of moderation and had provided power packs, batteries and screwdrivers to assist in the moderation. Moderators were greatly helped when projects were left with screws removed or loosened ready for examination. It is pleasing to report that very few candidates used glue to seal their cases or hot glue guns to hold printed circuit boards, speakers or batteries in place. This meant that moderators had to force entry into only a small number of projects so that moderation could be carried out. Centres need to make candidates aware of the moderation process and the need to design cases and packaging to accommodate routine maintenance and the need to change batteries.

Although the moderation process was relatively trouble free and centres are once again thanked for their contribution, there are a number of areas which need attention. Centres are reminded that *Centre Mark Sheets* need to be with the moderator no later than the date given by AQA. Centres with twenty or fewer candidates should include all the design folders, *Candidate Record Forms* and *Centre Declaration Sheet* when sending the *Centre Mark Sheets* to the moderator

The moderation period is extremely tight and centres are asked that they make a prompt response to moderators' requests by sending coursework sample material immediately by first class post. All centres need to complete and send to the moderator a *Centre Declaration Sheet* and each candidate requires a completed *Candidate Record Form* attached to the design folder. Several moderators have reported that a small number of centres had sent coursework material to them in a totally disorganised way and much time was spent in re-organising the material so that moderation could take place.

Due to a large number of matrix errors by centres this year, care needs to be taken when reading the assessment matrix and in transferring information to the *Centre Mark Sheets*. Internal standardisation of coursework needs to be carried out in centres where more than one teacher is teaching the specification.

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 a Design and Technology: '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 studying this specification will adopt a systems approach to designing their electronic circuits and that, for the award of higher grades A and B on the Full Course, candidates will normally have produced circuits which have process units built up from at least two basic building blocks. It has to be remembered that it is the processes that are being counted not the number of integrated circuits. A single logic Integrated Circuit (IC) or a Peripheral Interface Controller (PIC) can provide several processes.

Centres are reminded that candidates should design and make their own cases from suitable resistant materials or, significantly modify bought-in cases to demonstrate their Making skills ability. The product casing is expected to demonstrate the candidate's ability to design and make using appropriate resistant materials. Design of the casing may, for instance, result in the need for a particular shape and size of plastic container. A prototype of this casing could be made using vacuum forming or fabrication with suitable surface finish and internal and external detailing. Formers made by candidates for vacuum forming purposes should be kept and included in coursework for moderation. Fabrication of the casing from styrene sheets may be the most appropriate technique, especially where specialist workshops are not available. High quality prototypes can be made using a limited range of hand tools and equipment in multi-purpose rooms. The use of bought in boxes for casing may not allow candidates sufficient opportunity to demonstrate the required skills unless the boxes are significantly modified or added to by the candidate. It is emphasised that a number of centres this year allowed their candidates to spend too much time on the design and manufacture of the case in resistant materials at the expense of the electronics.

When designing, the main purpose of the design folder is to help candidates develop their ideas and to communicate their reasoning and conclusions. Electronic knowledge, skills and understanding should be the focus of the design folder. On a number of occasions, it was common to see design folders which were made up mainly of resistant materials technology, with a small amount of electronics included at the back of the folder. This resulted in candidates not being awarded the coursework grades they were capable of achieving.

It was still possible in this year's examination to see design folders that were bulky and padded out with irrelevant material and far exceeded the suggested timescale of 14 hours. Centres should take note of the following observations.

(i) Research and analysis were often confused and irrelevant. Far too often, research consisted of a collection of material cut out from magazines, catalogues or photocopied material and is of little use to candidates in informing the development of their ideas. Analysis frequently consisted of a list of unanswered questions, or took the form of a simple diagram. Practical research in the form of testing prototypes, reviewing data sheets, or testing if a circuit will work by using a kit, would be a far more fruitful source of information than that adopted by many candidates. A number of centres made excellent use of photography in the research and analysis sections.

(ii) Specification and evaluation were often weak or completely missing. The specification is important, as it focuses the design activity down to a number of parameters which give a clearer insight into what the candidate is attempting to do and can be used to measure the eventual success of the project. Evaluation was, for many candidates, an afterthought which revealed more about poor time management, instead of an objective on-going comparison of their designing and making against the specification.

(iii) Generation and development of ideas tended to be vague and undirected, and there was a tendency for many candidates to provide only a very limited range of ideas with little real development through to the chosen solution. It was rare to be able to identify the realisation from the final design drawing or working drawing. Many candidates printed off standard circuits from Crocodile Clips and then auto-routed the circuits through PCB Wizard, producing large and often untidy boards with no attempt by them to improve upon the PCB layout.

(iv) Graphical communication tended to be, for a number of candidates, the time consuming production of pretty colourful sheets containing borders, logos and cartoons with little relevance to the problem. Candidates should be encouraged to include rough work in their design folders to show how their work has developed through "thinking on paper". The use of fully dimensioned pictorial or orthographic drawings by candidates for their final working drawing needs to be encouraged by centres. Circuit diagrams were, in general, well presented and candidates need to take every opportunity to display their expertise at reading, interpreting and drawing circuit diagrams using the standard symbols as set out in the specification.

As in previous years, it is clear that a number of centres are uncertain about what to include in their coursework to satisfy designing and making with electronic components and the specific skills and processes that could be included in a successful project. The following points have been collated from Senior Moderators' comments and observations made in centres. It is hoped that centres will find them of help in preparing candidates for future examinations in Electronic Products.

DESIGNING SKILLS

Candidates should ensure they cover the full design process and satisfy the AQA assessment criteria as stated in the specification. They should evaluate their work at many stages throughout the project and not just at the conclusion of the project. Centres need to use the AQA *Candidate Record Form* to give feedback to the candidates on the progress of their designing and making skills.

Research - collect a wide range of electronic research material, make reference to books, data sheets, and component catalogues that the candidates have used. Carry out practical research in the form of testing circuit ideas, using kits, breadboards and computer simulation.

Analysis - break down the problem into a number of smaller problems or sub-systems. Analyse the research material and the electronic element of the problem. Use a systems approach and identify possible input, process and output devices. Use a variety of diagrams and charts, possibly supported by experimentation and, if need be, market research. The experimentation can be carried out with the use of kits or with the help of computer aided design.

Specification - a good electronic specification is crucial to the success of any Electronic Product project and will make it easier for the candidate to carry out the formative and summative evaluation. It may well be that the electronic specification is re-written a number of times as the candidate proceeds with the designing. Points worthy of consideration are the function of the system, the constraints of cost, size and time, the working parameters of input, process and output devices, a reference to power sources and assembly boards.

Generation of Ideas - involves the candidate in the gathering and exploration of circuits from any suitable resource. This can include material from books, data sheets and computer generated information. Candidates should sketch and draw out several designs e.g. three circuit ideas and two case ideas for the Full Course and two circuit ideas and one case idea for the Short Course. Case ideas should be relatively simple and appropriate to house an electronic circuit. At GCSE level, AQA is not expecting candidates to design electronic circuits from first principles, but rather to select and modify existing circuits to meet their needs. This will manifest itself in many ways but may involve the candidate in finding a way of interfacing a primary and secondary circuit, or changing the input and output devices, or finding a latching device, or re-designing a circuit to fit in a confined space. This type of activity will give the candidate the chance to hypothesise and carry out experiments using kits, software packages and breadboards to test their theories. It will also give the candidate the opportunity to use a range of measuring instruments and candidates should be encouraged to devise tests for their circuits and record their results. The use of photography in a candidate's design folder enhances the folder and is an excellent record of experimental work carried out with kits and breadboards. At this stage in designing, candidates should be encouraged to apply mathematical calculations and record this evidence in their design folder. Work on potential dividers, component ratings, time delays, frequency, current drain, battery life and the size of protective resistors are a few examples of where calculations can be applied. Centres need to ensure that candidates use and apply the given formulae in the specification wherever possible in their coursework.

Development of Solution **-** candidates should give reasons why they have selected a certain circuit from their generation of ideas and, equally, give reasons why they have rejected the other considered circuits. It may well be that the candidate has decided to take a number of sub-systems from discrete circuits and therefore needs to explain why. Candidates should present an accurate final circuit drawing which satisfies the specification and clearly takes into account relevant research and analysis. The circuit diagram should contain sufficient information for the circuit to be made by a competent third person. Depending upon the type of assembly board to be used, the candidate should design the component layout. This can include a variety of outcomes from printed circuit boards to matrix boards and pins. Whatever method is used, it is expected that the candidate will show evidence of planning the layout of the circuit for ease of component assembly, soldering, inspection purposes, position of input and output devices and final secure positioning of the circuit board in the external package. If Veroboard is used for example, candidates should show recorded evidence in their design folders of planning the component layout, the number of link wires required and the position of the breaks in the conductive tracks, etc. Equally, candidates who intend to use a printed circuit board should show the developmental stages of their PCB layout or transparent overlay. This type of activity gives candidates of all abilities the opportunity to involve themselves in electronic design and to show what they know and can do. This method of working contrasts greatly to the trend of many candidates who find a single circuit and use it without considering whether or not it can be improved upon. Many candidates use circuits from electronics magazines which are totally unsuitable for a GCSE course in Electronic Products and consequently have little or no understanding of how their chosen circuit works and are unable to fault find if the circuit fails to operate.

Planning of Making **-** Many of the points mentioned in the development of the final solution also fall into the category of planning of making. Candidates of all abilities are planning and making manufacturing decisions throughout their coursework, yet, very little of it is ever recorded. Flying leads are attached to input and output devices which are superbly insulated but no record of this activity can be found in the folder. Many candidates produce an external package for their electronic system by vacuum forming and, again, no mention is made of the need for a former and the necessity for draft angles and slight radii on the corners. Candidates fabricate cases from polystyrene sheet and design and make small assembly fixtures to hold the pieces together. Decisions are made to drill holes in the flat pieces prior to assembly. Unfortunately no record of these activities can be found in the folder. Planning of making should be well attempted by candidates of all abilities but, sadly, it is often omitted by even the most able of candidates.

Evaluation, Testing and Modification **-** involves the candidate in testing the project in the environmental conditions it was designed for and to see whether or not it will meet the demands of the specification. This part of the design process is poorly attempted by a significant number of candidates and is partly due to candidates completing their projects very close to the AQA deadline date. Centres need to make sure that candidates have sufficient time to complete this important section and to encourage candidates to think up interesting ways of testing their projects and the recording of the results, using block diagrams, pie charts, pictograms, etc. Alarms are very popular projects and if, for example, a candidate designs an anti-theft alarm for a bicycle the scope for testing and evaluation are immense. Once again, the use of photography can be encouraged to record testing and to highlight any suggested modifications to the system. This section of the assessment criteria is possibly the only place in the design folder that a candidate can carry out an extended piece of writing and gives candidates the opportunity to reflect upon the whole process. Candidates need to be made aware that there are five marks available for the Quality of Written Communication and, with reasonable care, most candidates should be able to gain three to five marks for this aspect of their coursework.

Use of Communication, Graphical and Use of I.C.T. Skills. **-** throughout their design folders, candidates should be encouraged by centres to show a wide range of communication skills and techniques and use information technology and appropriate software packages to generate circuit diagrams and printed circuit board overlays and the simulation of circuits on screen.

Social Issues, Industrial Practices and Systems and Control (including the use of CAD) **-** As the emphasis on industrial and commercial practices in the new Design and Technology specifications has increased, it is reasonable to expect candidates from all types of centres making use of the facilities that these applications offer. Although the resources available to centres varies from one centre to the next, the resources in the most well equipped centres cannot compare to the facilities available to modern manufacturing companies. When candidates are designing and making their coursework projects, they are naturally limited to using the facilities available in the centre. If, for example, CAD/CAM is available, candidates should try and apply it in a relevant way to their project work. If CAD/CAM is not available, candidates need to demonstrate an understanding of their application in an industrial setting and be able to compare and make recommendations on how their coursework would change or be influenced if CAD/CAM was used.

As the candidates proceed to design and make their coursework projects, they should be encouraged to contrast their centre based work patterns against industrial work patterns for a similar task. Evidence of industrial practices should flow through the design folder and not be an addition at the end of the folder simply to show its use. The gathering of evidence for industrial practices can be presented as bullet points on relevant pages, or short statements. The key to candidate success is making industrial practices relevant to the project and involving the candidates in reflective thinking and comparisons.

Evidence of Industrial Practices

CAD - Circuit design and testing
CAD - PCB design and mask
CAD - Design of cases
CAM - PCB mask and PCBs
CAM - Manufacture of cases

Scale of production – one off, batch and mass production

Production Methods
Pick and place component assembly machines
Vacuum forming machines
Injection moulding machines

Laser cutting machines
CNC machines
Jigs and fixtures

Inspection Methods and Equipment
Quality Control
Quality Assurance

Systems and Control - As electronic circuits are examples of a system and all have some kind of control, it should therefore be possible for all candidates to cover systems and control within their electronic design and making coursework.

Social Issues **-** As electronic systems become more sophisticated and cheaper to purchase than ever before, they will interact more and more upon society. Many of these interactions will benefit society greatly. Sadly, some will not and will cause massive disruptions to society and individuals. The world of electronics has already impinged upon the emergency services, the home, medical services, industry, commerce, leisure, entertainment, education, scientific research, shops, offices, transport and weather forecasting. Candidates should be able to describe the possible implications for society, including advantages and disadvantages of the interaction with the electronic age. Much of the information will come from newspapers, magazines, television reports, class videos and teacher handouts.

REALISATIONS

Each year, moderators report that a number of candidates achieved low grades as a result of not completing a project which was too difficult for them to attempt or not suitable for the Electronic Products specification. Centres should endeavour to match the appropriateness of a project to the ability of the candidate. It is advantageous to the candidate, both academically and motivationally, to complete a project and see it working. It is hoped that the following points will be useful to centres and be a checklist for candidates.

Is the circuit safe to use?
Is the circuit complete?
Does the circuit work?
Is the circuit board secure in the package?
Can the circuit board be easily removed for inspection?
Is the battery secure in the package?
Is there easy access to the battery?
Are all wires and connections tidy?
Are all flying leads and battery connections anchored to the circuit board?
Are all connections to switches and devices sleeved and insulated?
Is the quality of the soldering to an acceptable standard?
Is the circuit complex to make?
Is the appearance of the circuit attractive?
Does the circuit keep breaking down?

Building Quality Assurance into Coursework

Although centre workshops and laboratories are vastly different to the facilities available to manufacturing companies, nevertheless, candidates can still consider and include aspects of Quality Assurance into their work.

When designing the PCB mask, candidates should always make the circuit as small as it is practically possible. Yet, it must be remembered that AQA will not withhold grades if a candidate designs a large PCB. It is a question of getting the balance right. A very small PCB can be extremely difficult to populate and solder. Candidates should make sure that the tracks of the PCB are wide enough to carry the required current and withstand the etching process. The size of pads should be big enough to assist the soldering process. Where possible, the PCB mask should be designed with all common components, for example, diodes, resistors and capacitors next to each other as this will greatly speed up the assembly time.

All flying leads can be anchored to the PCB by strain holes, thus adding a mechanical joint to assist the soldered joint. Input and output devices such as Switches and Light Emitting Diodes can be insulated and stop the possibility of shorting the circuit. The PCB and battery should be held secure in the case with easy access when changing the battery.

It is common to find candidates making the tracks of printed circuit boards very thin and pads very small and then having great difficulty in trying to solder components in place. Many a poorly soldered circuit is the result of a badly designed printed circuit board and centres should try to remove the minimum amount of copper the circuit design will allow.

A number of moderators reported that several centres had used electronic modelling kits and breadboards in the candidates' final realisation. Centres are reminded that the use of these kits is more appropriately assessed in the designing criteria than the making criteria. A small number of moderators reported that several candidates had completed electrical projects which did not include any active electronic devices. The attention of centres is drawn to the difference between an electronic project and an electrical project and that it is expected that the electronic circuit will be hard wired and components soldered in place. It is also apparent that a number of centres are allowing candidates to work with circuits powered by mains electricity. AQA stresses that this should be avoided as the Electronic Products specification can be delivered without the need of this type of electrical supply.

Peripheral Interface Controllers (PICS)

Centres need to remind candidates who are intending to include PICs in their coursework projects of the assessment stages contained within the assessment criteria and to ensure that candidates address them. The tendency with some candidates is to state right from the beginning of the design folder that they are planning to use a PIC and no further thought is given to alternative ways of solving the problem. Candidates preparing coursework for Electronic Products should be using a systems approach and identifying the building blocks for the INPUT, PROCESS and OUTPUT sections of the system and, if a PIC is chosen as the most suitable building block for the process section, it should be arrived at by way of investigation. A problem that would challenge the brightest of candidates if they had to solve it by using only discrete components can be radically simplified by using a programmable integrated circuit. This means that an area of project work well above the standard normally associated with GCSE is accessible to candidates who use PICs. It is therefore of paramount importance that candidates show in their design folders a sound understanding of the implications of using PICs in their coursework. It is not uncommon to see a candidate using a PIC with a single design idea and little or no explanation of the importance of the microcontroller program with a written understanding of what is taking place.

Short Course

The main body of text for the Full Course also refers to the Short Course but the following specific points should also be noted.

It was apparent in a number of centres that candidates had spent a higher number of hours working on their coursework than the 20 hours stated by AQA for the Short Course specification, and they may have been better suited for entry to the Full Course. Indeed, a considerable number of candidates had produced coursework of a standard good enough to satisfy the higher grades on the Full Course.

Candidates are expected to adopt a systems approach to designing their circuits and may achieve the higher grades with high quality use of process units made from a single building block circuit. Centres, however, should encourage candidates to combine circuits where appropriate.

Mark Ranges and Award of Grades

Full Course

Foundation tier

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
Paper	125	140	56.9	24.1
Coursework	95	210	116.5	41.7
Foundation tier overall 3541/F	--	350	173.4	55.2

		Max. mark	C	D	E	F	G
Paper boundary mark	raw	125	77	64	52	40	28
	scaled	140	86	72	58	45	31
Coursework boundary mark	raw	95	60	48	36	24	12
	scaled	210	133	106	80	53	27
Foundation tier scaled boundary mark		350	209	172	135	98	61

Higher tier

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
Paper	125	140	76.4	20.1
Coursework	95	210	167.9	32.7
Higher tier overall 3541/H	--	350	244.2	44.9

		Max. mark	A*	A	B	C	D	Allowed E
Paper boundary mark	raw	125	98	86	74	63	50	-
	scaled	140	110	96	83	71	56	-
Coursework boundary mark	raw	95	95	83	71	60	48	-
	scaled	210	210	184	157	133	106	-
Higher tier scaled boundary mark		350	304	270	236	203	162	141

Although component grade boundaries are provided, these are advisory. Candidates' final grades depend on their total marks for the subject. In particular, A* is determined on candidates' total marks, not on each component, and candidates do not have to obtain 95 marks on the coursework component in order to gain grade A* on the subject as a whole.

Provisional statistics for the award

Foundation tier (7091 candidates)

	C	D	E	F	G
Cumulative %	27.9	52.3	71.6	85.0	93.2

Higher tier (6915 candidates)

	A*	A	B	C	D	allowed E
Cumulative %	7.2	30.1	60.2	83.7	94.9	97.9

Overall (14005 candidates)

	A*	A	B	C	D	E	F	G
Cumulative %	3.6	14.9	29.7	55.4	73.4	84.2	91.0	95.2

Short Course

Foundation tier

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
Paper	100	120	53.4	20.9
Coursework	95	180	108.0	37.5
Foundation tier overall 3551/F	--	300	161.4	49.3

		Max. mark	C	D	E	F	G
Paper boundary mark	raw	100	64	52	41	30	19
	scaled	120	77	62	49	36	23
Coursework boundary mark	raw	95	60	48	36	24	12
	scaled	180	114	91	68	46	23
Foundation tier scaled boundary mark		300	184	149	115	81	47

Higher tier

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
Paper	100	120	75.3	15.7
Coursework	95	180	155.1	25.7
Higher tier overall 3551/H	--	300	230.4	33.8

		Max. mark	A*	A	B	C	D	allowed E
Paper boundary mark	raw	100	87	78	69	60	50	-
	scaled	120	104	94	83	72	60	-
Coursework boundary mark	raw	95	95	84	72	60	48	-
	scaled	180	180	159	136	114	91	-
Higher tier scaled boundary mark		300	276	246	216	186	151	133

Although component grade boundaries are provided, these are advisory. Candidates' final grades depend on their total marks for the subject. In particular, A* is determined on candidates' total marks, not on each component, and candidates do not have to obtain 95 marks on the coursework component in order to gain grade A* on the subject as a whole.

Provisional statistics for the award

Foundation tier (338 candidates)

	C	D	E	F	G
Cumulative %	34.6	61.2	78.4	89.6	95.9

Higher tier (269 candidates)

	A*	A	B	C	D	allowed E
Cumulative %	5.9	37.5	70.3	87.7	98.5	99.3

Overall (607 candidates)

	A*	A	B	C	D	E	F	G
Cumulative %	2.6	16.6	31.1	58.2	77.8	87.6	93.9	97.4

Definitions

Boundary Mark: the minimum (scaled) mark required by a candidate to qualify for a given grade. Although component grade boundaries are provided, these are advisory. Candidates' final grades depend only on their total marks for the subject.

Mean Mark: is the sum of all candidates' marks divided by the number of candidates. In order to compare mean marks for different components, the mean mark (scaled) should be expressed as a percentage of the maximum mark (scaled).

Standard Deviation: a measure of the spread of candidates' marks. In most components, approximately two-thirds of all candidates lie in a range of plus or minus one standard deviation from the mean, and approximately 95% of all candidates lie in a range of plus or minus two standard deviations from the mean. In order to compare the standard deviations for different components, the standard deviation (scaled) should be expressed as a percentage of the maximum mark (scaled).