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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Design and Technology (Electronic Products) 3541/3551

Report on the Examination

2006 examination - June series

- Full Course
- Short Course
- Coursework

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General Comments

The papers were accessible to candidates. There were very encouraging responses to the questions and centres are to be congratulated on the level of preparation of their candidates.

Full Course Foundation Tier

The majority of candidates found this paper accessible. Few candidates scored above ninety marks, however, with two questions proving to be difficult for Foundation Tier candidates. These were Question 3(a), the PCB production, and Question 5(b), the PIC microcontroller.

Question 1

(a) Well answered, although few candidates recognised the variable resistor.

(b) This question was very well answered.

Question 2

(a) Well answered, with many candidates gaining full marks.

(b) Although the majority of candidates noted that the LED would light, few mentioned the latching action of the thyristor.

(c) Part (i) was well answered. In part (ii) candidates generally scored two or three marks, but did not provide the necessary detail, or number of advantages, to gain full marks.

Question 3

(a) This was answered poorly. A number of candidates gave the impression that they may have seen the PCB manufacturing process, but showed little evidence that they had actually produced their own. The answers were generally superficial and major stages, such as developing, were not mentioned.

(b) Generally well answered, with most responses gaining full marks. However, some candidates lost marks by simply naming a process, rather than the specific hazard associated with that process.

(c) Most candidates scored at least one mark, but a common response was ‘testing the circuit with power’, or simply ‘see if it works’.

(d) Most responses scored one mark, but there was some confusion over the names of test equipment. Many candidates referred to testing of the actual battery, rather than the circuit itself.

Question 4

(a) Part (i) was well answered. In part (ii) the majority of candidates responded appropriately and gained good marks.

(b) In general, candidates scored well on this question. A high number of candidates sketched designs that could not possibly be vacuum-formed and so did not gain full marks. The quality of drawing and detail of notes varied enormously, but the general standard did not match that seen in previous papers.

(c) Almost all candidates attempted the question, but few sketched a method of securely fastening the bike light. There were many references to ‘velcro’ and ‘horseshoe’ clips.

Question 5

(a) Responses to this question tended to be rather vague, lacking detail and showed a limited knowledge of PICs.

(b) This question was well answered by a small number of candidates, but it was clear that a number of centres had not prepared their candidates for this type of question. Candidates had not studied, or perhaps not used, PIC systems at all and, therefore, candidates were merely copying or re-writing the question and hence scored low marks.

Question 6

(a) This was a well answered question.

(b) Most candidates scored well in parts (ii) and (iii), but most struggled with drawing the resistor / capacitor. Part (iv) was poorly answered, with very few candidates correctly drawing a transducer driver or lamp. The quality of drawing was reasonable, but it was surprising how few candidates used a ruler to draw straight lines.

(c) A very poor level of response. Virtually all those who answered thought that the 555 gave out too much current and that the lamp would ‘blow’.

(d) Most candidates scored at least two marks by writing the formula and substituting correct values, but few calculated the correct answer. Candidates are advised to include units in their answers to questions such as this.

Question 7

This question gave all candidates the opportunity to score well and most did. Part (b) was often answered rather vaguely though and answers often lacked the detail to gain four marks.

Full Course Higher Tier

Whilst many centres had candidates who demonstrated a thorough understanding across the paper, a significant number of centres had candidates who displayed large gaps in their knowledge.

Question 1

(a) This was well answered by the majority of candidates, with many focusing on ergonomic and safety considerations. However, a number of candidates failed to provide explanations, thereby failing to gain three marks.

(b) Only a small number of candidates displayed a clear understanding of the latch function of the thirstier, most only recognising that the LED was turned ON (I) and OFF (ii). A number of candidates clearly did not have a full knowledge of the symbols given in the Specification and this was demonstrated by mistaking the thirstier for a second LED.

(c) Part (I) was well answered. In part (ii), the best answers used four bullet points; many candidates lost marks by not clearly addressing four areas. Many candidates failed to mention basic facts such as the ability of CAD to save work, print multiple copies and have exact component spacing.

Question 2

(a) This part was not well answered. Despite the question having ten marks, many candidates gave insufficient detail to access the top marks, in particular missing aspects of Quality Control. A significant number of candidates failed to read the question carefully enough and gave details concerning drilling and soldering, although the question explicitly said ‘prior to’ these stages. Most candidates used the form of a flow diagram to answer the question, which gave a clear structure to their response.

(b) This was generally well answered, with specific hazards usually given along with suitable precautions.

(c) This question was poorly attempted by some candidates who confused Quality Control with testing to see if the circuit worked. The candidates who were clear in their responses listed checking polarity, quality of component assembly, integrity of tracking and soldering etcetera and had clearly carried out Quality Control checks on their own projects.

(d) Many candidates only picked up one mark, as they either failed to correctly name a relevant piece of test equipment or to describe its correct use.

Question 3

(a) (I) Well answered, with the vast majority of candidates avoiding using the generic term of plastic.

(ii) A wide range of responses were seen, but most candidates scored well.

(b) There were some very high quality answers to this question, with candidates displaying good graphical skills and preparation. However, some candidates failed to use even the most basic equipment to improve the quality of their sketches. The annotation of sketches was much improved from last year, allowing access to the higher marks. The more able candidates gave clear secondary sketches of LEDs etcetera fixed by bezels or grommets and plainly showed the use of screws, bolts or similar mechanisms to secure the case.

(c) Candidates generally scored well here, but many responses did not include a method of making the attachment secure.

Question 4

(a) Whilst most candidates correctly compared the two different components, many responses lacked the detail required to gain the marks.

(b) This was very well answered by those candidates who had clearly used PICs and had experienced using control programmes. A large number of candidates had very little idea what a PIC is and many just copied out the question again as an answer. A number of otherwise good answers lost marks because of a failure by the candidate to read the question fully, thus missing out complete stages – in particular the stage given in bold in the question.

Question 5

(a) This question was well answered by the majority of candidates, although some confused a 'logic state' with what it represents.

(b) Although some candidates lost marks in part (ii) by poor quality freehand drawing or very confused circuit layouts, the majority scored well.

Question 6

(a) Nearly all candidates correctly identified the LDR and most were able to gain marks for the calculation. It was therefore surprising that part (iii) proved difficult for many candidates.

(b) There was an improvement over last year's attempts at the Op Amp questions. Most of the candidates demonstrated an understanding of connecting the Op Amp to a potential divider. A number of candidates, however, could not connect the LED correctly to Pin 6.

Question 7

Many candidates scored full marks on this question. Few candidates answered succinctly or used bullet points, which could have made their answers clearer.

(a) A number of candidates failed to refer specifically to the impact on work.

(b) Examiners saw a number of vague answers to this question, with many candidates seemingly confused by the term “consumers”.

(c) A much better understanding was shown here than in the other parts to this question.

Short Course Foundation Tier

Although only a small number of candidates took this paper, a wide range of marks were achieved and the paper was accessible to all candidates.

Question 1

Both parts were generally well attempted with candidates showing confidence with this type of question.

Question 2

(a) Well answered, although a few candidates failed to gain marks through lack of reasoning or through repeating answers.

(b) Limited responses were seen, with many candidates unfamiliar as to the function of the thyristor.

(c) Part (i) was usually well attempted but part (ii) received a mixed quality of responses, with many candidates not including enough detail to gain the marks.

Question 3

(a) Some disappointing responses were seen, which suggested many candidates had not actually been involved in producing their own circuit boards. Quality control checks were rarely mentioned.

(b) Well answered, but some candidates failed to give specific hazards.

(c) Reasonably well attempted although quite a few candidates confused Quality Checks with testing the circuit.

(d) This part received a mixed quality of response. Few candidates identified a suitable device and correctly described its use.

Question 4

(a) Suitable material was usually identified in part (i) but there were very variable responses to part (ii). The best answers combined clear sketches with notes.

(b) The standard of sketching was variable, but the level of annotation was much better.

(c) Unfortunately, there were some very limited ideas from many candidates.

Question 5

(a) This question was well answered by candidates.

(b) This was better attempted than similar questions in previous years.

(c) Candidates struggled with this calculation, but many gained some marks by making an attempt.

Question 6

(a) Whilst most candidates gained some marks, many did not consider both the advantages and disadvantages.

(b) Better responses were seen for this question part, but many answers were still very general and vague.

Short Course Higher Tier

The quality of drawings and sketches in Question 3 was good, with candidates spending time ensuring clarity. The quality of notes accompanying the drawings was also good. Some centres may, in the future, wish to advise candidates to leave the drawing questions to the end of the examination, so that candidates can spend more time on their drawings and not rush them.

Question 1

(a) This was well answered, with most candidates identifying relevant design factors and giving reasons.

(b) In parts (i) and (ii) most candidates referred to the LED switching on or off, but few discussed the thyristor latching.

(c) A very well answered question.

Question 2

(a) It was clear that some centres' candidates had manufactured their own PCBs at some stage, and were able to respond well although very few gained the full ten marks. A small number of candidates seemed to have little or no knowledge or experience of PCB manufacture. Few candidates incorporated an element of checking, or quality control, but most identified the major stages of production.

(b) Parts (i) and (ii) were generally well answered, with most candidates gaining full marks. However, some candidates lost marks by simply naming a process, rather than the specific hazard associated with that process.

(c) Quite well answered, with the majority writing about specific checks that could be undertaken.

Question 3

(a) (i) Well answered, with the vast majority of candidates avoiding using the generic term 'plastic'.

(ii) Well answered, with most candidates scoring significant marks. Some of the sketches were of excellent quality, accompanied by detailed notes.

(b) Candidates tended to score well on this question. Some candidates sketched designs that could not possibly be vacuum formed and so did not gain full marks, and some candidates still seem to consider some strange methods of holding LEDs, including gluing.

(c) Almost all candidates attempted this question, but few sketched a method of securely attaching the light. There were a lot of references to 'Velcro' and 'horseshoe' clips.

Question 4

(a) Generally well answered, with candidates identifying a range of differences between a PIC and a 555.

(b) This was answered well by some candidates, and very poorly by others. Marks awarded tended to be either very high, or very low. Some candidates had clearly studied PICs in some depth, and had used programming systems to produce electronic systems. These candidates tended to score highly.

Question 5

(a) This was a well answered question.

(b) Candidates scored well when drawing the timing potential divider and the resistor / PTM input but many struggled with part (iv). It would appear that the term ‘transducer driver’ confused a lot of candidates. The quality of drawing was generally very good, with candidates producing neat, straight lines and components drawn in proportion.

(c) This question was answered poorly. The majority of candidates thought that the lamp would ‘blow’ because of too much current.

(d) Most candidates scored at least two marks by writing the formula and substituting correct values, but few calculated the correct answer. A number of candidates failed to include units in their answers.

Question 6

This question was very well answered. Candidates clearly understood that, for three marks, three points need to be raised, or that some detail or qualification is needed. The majority scored very highly with this question.

Coursework

Centres which were involved in the moderation process of Electronic Products coursework in 2006 are to be congratulated on the excellent way candidates' work 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. Many centres provided batteries, screwdrivers and, in some cases, written instructions describing how the projects worked, which assisted in the moderation. Moderators were greatly helped when projects were left with screws removed from cases or loosened ready for examination. It was also helpful to moderators when PCBs were removed from PCB pillars, allowing for the inspection of soldering and circuit build quality. 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, seven segment displays or batteries in place. 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.

The moderation time period is extremely tight and, although the moderation process was relatively trouble free and centres are once again thanked for their contribution, there are a number of areas which do need attention:

Centres are reminded that Centre Mark Sheets need to be with AQA and the moderator no later than the 5^{th} May.

Centres with twenty or fewer candidates should include all coursework folders when sending the Centre Mark Sheets to the moderator.

Centres need to complete and send to the moderator a Centre Declaration Sheet.

Each candidate requires a completed Candidate Record Form attached to the design folder with grades for each assessment stage and appropriate annotation where necessary. These must be signed by both the candidate and the teacher.

Candidate design folders should be individually fastened together in a logical order to assist the moderation process.

Bulky ring binders should not be sent to the moderator.

Care needs to be taken by centres when using the Assessment Matrix.

Where two or more teachers are involved in teaching Electronic Products, internal standardisation must take place.

Centres are asked that they make a prompt response to moderators' requests.

Moderators are greatly assisted if centres enclose a map, travel directions, and a contact name if the moderator is to visit the centre.

The Design and Technology (Electronic Products) specification is an electronics design and make course with the emphasis on product design, using appropriate casing materials to package the electronic circuitry. 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 casing 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 and the importance of meeting targets.

As 60% of the final 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 two thirds of the coursework marks are allocated for the making of the project and projects, therefore, should be made to the highest quality the candidate is capable of producing. The design folder represents one third of the coursework marks and should demonstrate the progress of a candidate's thinking through the use of a range of communication skills. 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.

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 rather than the number of integrated circuits. A single logic Integrated Circuit (IC) or a Peripheral Interface Controller (PIC) can provide several processes. As a guide, candidates should produce three electronic circuit ideas and two case ideas.

Centres are reminded that candidates should design and make their own cases from suitable materials, or 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 casing materials. A wide range of casing materials can be used including resistant materials, textiles and card. 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.

The use of bought-in boxes for casings is acceptable. With a purchased case, it is the work in modifying the basic case to accommodate the electronic system which gains the credit. This could include the drilling of holes for Input and Output devices, the cutting of slots for switches, seven segment displays, liquid crystal displays and the making of internal compartments within the box to hold the PCB and battery secure. Evidence of design modifications to bought-in boxes should be shown in the design folder as drawings, sketches and notes. It is emphasised that a small 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 a disproportionate amount of time spent on sections of the design folder, for example, designing the front cover, copying out theory notes without reference to the project, letters, questionnaires and irrelevant cut and paste research from the internet and shopping magazines to the detriment of design development and the practical work. This resulted in candidates not being awarded the coursework grades they were capable of achieving.

A higher number of centres than in previous years set a single coursework project theme, an example being the design and manufacture of an alarm system. Although this is acceptable, and a number of centres use this approach successfully each year producing a wide range of very different electronic circuits and cases, the evidence from this year's moderation shows that some centres, by setting a single theme, are restricting the candidates' individual responses when designing and making. It was common to see a whole group of candidates with the same analysis, research, circuit ideas and an identical or very similar PCB. Most of the research and circuit ideas consisted of photocopied material with no comment by the candidate to justify its inclusion or an explanation of how it will be used, modified or rejected. In these circumstances, a lack of annotation by centres also made moderation difficult as it was not always clear to see where grades had been awarded to candidates whose work, although very similar in content and quality, had been given very different grades. On a number of occasions, this resulted in a centre's coursework having to be re-marked and candidates' grades adjusted. Centres need to endeavour to offer a range of projects or to ensure that a single project theme will enable candidates across the ability range the opportunity to fully demonstrate their designing and making capabilities.

As in previous years, it is clear that a number of centres are uncertain about what to include in their coursework so as 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. However, if you need help or advice, please contact your Coursework Adviser, who should be able to offer advice on suitable projects.

DESIGNING SKILLS

Candidates should ensure they cover the full design process and satisfy the AQA assessment criteria as stated in the specification. Candidates 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 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. General research is not worth including, unless it is used in the design that is being produced.

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 target market, the constraints of cost, size and time, the working parameters of input, process and output devices, a reference to power sources, assembly boards, packaging of the electronics and environmental issues.

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 or draw out by any means, several designs, e.g. three circuit ideas and two case ideas for the Full Course. Case ideas should be relatively simple and appropriate to house an electronic circuit. At GCSE level, AQA is not expecting candidates to design original 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 veroboard.

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 and web sites which are totally unsuitable for a GCSE course in Electronic Products. Consequently they have little or no understanding of how their chosen circuit works and are unable to fault find the circuit if it fails to operate as expected.

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. Moderators have seen examples of flying leads being attached to input and output devices which are superbly insulated. but with no record of this activity 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 of cases prior to assembly but, 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 brightest 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 5th May 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 or pie charts. 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 is 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, printed circuit board overlays, the simulation of circuits on screen and the design of cases to package the electronic circuit.

Social Issues, Industrial Practices and Systems and Control (including the use of CAD) - as the emphasis on industrial and commercial practices in the 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 vary 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
Candidates need to show in their design folders, evidence that they have used, considered and taken into account a range of industrial practices.

Examples are:

Evidence of CAD when designing electronic circuits and cases.

Evidence of CAM when making PCBs, PCB masks and cases.

Attaching flying leads to input and output devices – refer to insulation and colour coding.

Evidence of Quality Assurance when drilling strain holes in PCBs for flying leads to protect the soldered joint. Colour coding polar components for correct position in circuit.

Soldering components onto a PCB by the through hole method, compared against surface mount method with reference to Pick and Place Component machines.

Making PCBs by the wet method compared against dry methods.

Evidence of Quality Control when checking PCBs by visual inspection and by the use of multimeters.

The advantages of using IC sockets to protect ICs against damage and ease removal.

Health and Safety when making PCBs, soldering and using machine tools.

If using vacuum forming, show the design of the former, refer to draft angles and the need for radii on the corners. Keep former for evidence of making.

If templates and jigs are needed, include a sketch or drawing to explain how they will be used.

When fabricating a case, include a detailed and dimensioned drawing. Explain how it will be made and compare against other ways of making cases, for example, by laser technology.

Explain the advantages of using ICs in place of discrete components.

Explain the advantages of using PICs compared to discrete ICs.

Show evidence of the use of PICs in coursework.

Show evidence of PIC programming. Try to give two or three examples. Programmes can be developed in the same way as PCBs with printouts.

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 when designing with electronic components by referring to a systems diagram.

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 and will be excellent preparation for the written paper.

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 in the first place, or not suitable for the Electronic Products specification. Centres should endeavour to match the appropriateness of a project to the ability of the candidate and the Electronic Products specification. It is advantageous to the candidate, both academically and motivationally, to complete a project and see it working.

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.

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. An increasing number of candidates are using the Autorouting facility on CAD packages and, in many instances, the overall quality of PCB design and manufacture is extremely poor.

Electronic circuit build quality can be improved by securing flying leads to the PCB with 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 reduce the possibility of shorting the circuit. The PCB and battery should be held secure in the case with easy access when changing the battery.

Moderators reported that a very small number of 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 dangerous electrical supply.

USING PICs IN ELECTRONIC PRODUCTS COURSEWORK

Many more candidates are using PICs in their coursework projects than in previous years. Candidates who intend to use a PIC in their coursework project need to be reminded by the centre of the coursework assessment criteria. 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, identifying the building blocks for the **INPUT, PROCESS AND OUPUT** sections of the system. 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 and ICs can be radically simplified by using a programmable device. 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 programme. This would suggest that the candidate had little understanding of what was taking place.

Candidates who decide to use PICs in their coursework need to show a clear understanding of the relationship between discrete components and the task they perform and their relationship to the function of the PIC and its programme. The assessment procedures will be looking at the **process** the candidate goes through, where the candidate starts and where he or she **finishes** and the **decisions** that are made along the way. There is no guarantee that by using a PIC high grades are assured. It may be that a PIC has replaced a discrete component system that consisted of a Schmitt Trigger, Monostable, Astable, Counter and Simple Logic and the candidate needs to demonstrate the relationship between the discrete systems and the programmable integrated system.

If a candidate uses a PIC within a design process framework, their coursework should be enhanced by the programming skills necessary to solve the problem. Input, Output and Transducer Drivers still need to be identified and appropriate calculations carried out on, for example, Potential Dividers.

Areas of Concern with the use of PICs in Centres

Candidates are not providing a range of electronic design ideas.
Candidates are not providing evidence of PIC programming.
Candidates are using the same PIC program.
Candidates are using identical PCB designs.
Candidates are using commercially made bought in PCBs.
Many candidates who use PICs are not fully satisfying the Assessment Criteria.

CHECKLIST FOR CANDIDATES OF ELECTRONIC PRODUCTS WHO INTEND TO USE PICS IN THEIR COURSEWORK

Start with a problem.
Use a Systems Approach.
Identify the Input, Process and Output stages of the system.
Work through a Design process.
Find alternative circuit ideas (3 circuit ideas for the Full Course).
Select the PIC by investigation and give reasons why.

Show an understanding of the relationship between the PIC and the discrete process building blocks which it has replaced.

Design the PIC programme. (Show development and ideas)

Show an understanding of the PIC programme. (Explanations)

Design the PCB layout.

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 of 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. As a guide, candidates should produce two electronic circuit ideas and one case idea.

Mark Range and Award of Grades

Full Course

Foundation tier

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
Paper	125	140	63.7	19.5
Coursework	95	210	128.6	40.7
Foundation tier overall 3541/F	--	350	192.4	51.4

		Max. mark	C	D	E	F	G
Paper boundary mark	raw	125	81	72	63	55	47
	scaled	140	91	81	71	62	53
Coursework boundary mark	raw	95	60	48	36	24	12
	scaled	210	133	106	80	53	27
Foundation tier scaled boundary mark		350	218	183	149	115	81

Higher tier

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
Paper	125	140	86.24	22.2
Coursework	95	210	175.5	28.5
Higher tier overall 3541/H	--	350	261.8	42.6

		Max. mark	A*	A	B	C	D	allowed E
Paper boundary mark	raw	125	106	98	90	83	68	-
	scaled	140	119	110	101	93	76	-
Coursework boundary mark	raw	95	95	84	72	60	48	-
	scaled	210	210	186	159	133	106	-
Higher tier scaled boundary mark		350	317	284	255	226	182	-

Provisional statistics for the award

Foundation tier (5123 candidates)

	C	D	E	F	G
Cumulative %	33.9	60.8	76.9	87.0	93.4

Higher tier (5888 candidates)

	A*	A	B	C	D	allowed E
Cumulative %	8.0	33.6	60.9	82.0	95.8	97.8

Overall (11011 candidates)

	A*	A	B	C	D	E	F	G
Cumulative %	4.3	18.0	32.6	59.6	79.5	88.0	92.7	95.7

Short Course

Foundation tier

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
Paper	100	120	67.9	23.52
Coursework	95	180	110.0	19.3
Foundation tier overall 3551/F	--	300	177.7	33.0

		Max. mark	C	D	E	F	G
Paper boundary mark	raw	100	75	64	54	44	34
	scaled	120	90	77	65	53	41
Coursework boundary mark	raw	95	60	48	36	24	12
	scaled	180	114	91	68	45	23
Foundation tier scaled boundary mark		300	194	162	1130	98	66

Higher tier

Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
Paper	100	120	79.7	13.6
Coursework	95	180	163.3	21.7
Higher tier overall 3551/H	--	300	243.5	28.0

		Max. mark	A*	A	B	C	D	allowed E
Paper boundary mark	raw	100	88	80	72	65	58	-
	scaled	120	106	96	86	78	70	-
Coursework boundary mark	raw	95	95	84	72	60	48	-
	scaled	180	180	159	136	114	91	-
Higher tier scaled boundary mark		300	277	249	220	192	161	-

Provisional statistics for the award

Foundation tier (30 candidates)

	C	D	E	F	G
Cumulative %	33.3	63.3	83.3	93.3	100.0

Higher tier (138 candidates)

	A*	A	B	C	D	allowed E
Cumulative %	5.8	44.2	79.0	96.4	99.3	100

Overall (166 candidates)

	A*	A	B	C	D	E	F	G
Cumulative %	6.0	42.2	69.9	83.7	92.2	95.8	97.6	98.8

Definitions

Boundary Mark: the minimum mark required by a candidate to qualify for a given grade.

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).

Uniform Mark: a score on a standard scale which indicates a candidate's performance. The lowest uniform mark for grade A is always 80% of the maximum uniform mark for the unit, similarly grade B is 70%, grade C is 60%, grade D is 50% and grade E is 40%. A candidate's total scaled mark for each unit is converted to a uniform mark and the uniform marks for the units which count towards the AS or A-level qualification are added in order to determine the candidate's overall grade.