OCR
Oxford Cambridge and RSA

GCSE

Design and Technology: Electronic and Control systems

General Certificate of Secondary Education **J301**

OCR Report to Centres June 2015

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This report on the examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the specification content, of the operation of the scheme of assessment and of the application of assessment criteria.

Reports should be read in conjunction with the published question papers and mark schemes for the examination.

OCR will not enter into any discussion or correspondence in connection with this report.

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General Certificate of Secondary Education

Design and Technology: Electronic and Control Systems (J301)

OCR REPORT TO CENTRES

A511 Introduction to Designing and Making

General Comments:

20 hours are allowed for the completion of the A511 controlled assessment. There are 60 marks available for the Unit.

One hour's work should enable a candidate to attain 3 marks. It was evident that some candidates had spent too much time on the CREATIVITY and DESIGNING sections.

It is important that candidate responses are concise and completely relevant to the theme.

The majority of centres helped the moderation process to run smoothly, by providing the correct paperwork, close to the coursework deadline. Most centres were familiar with the requirements of the controlled assessment unit. There was an improvement in administration this year, with few difficulties in regard to completion of the MS1 forms and transfer of marks to OCR.

The majority of centres are to be congratulated on the annotation recorded on candidates' work. When dealing with large numbers of candidates this becomes a time consuming exercise. However, the application of the mark scheme is far more consistent when teachers justify the awarding of marks. There is a clear indication of why candidates deserve the marks.

Centres should note the specification, which clearly indicates that a 'best fit' approach should be utilised when marking work. Candidates work can be judged as basic, sound or high ability.

The vast majority of the coursework seen during the moderation was relevant to a GCSE standard. However, centres are reminded that in this unit, a candidate needs to produce a prototype system, not a product. There needs to be a greater emphasis on the control of the proposed system.

Many candidates fail to understand the difference between a product and a system.

A PCB or a mechanism allows ample opportunity for candidates to suggest how the proposed system operates by listing and explaining the purpose of the input devices; how the PCB or the mechanism is controlled and what is the effect of the output device(s). These features are unique to the specification.

Overall, centres are to be congratulated on meeting the needs of the moderation process.

Specific Comments on:

Creativity

It was pleasing to see that most centres used the set themes provided by OCR to identify a suitable need and user group. There was good use of Mind Maps and Mood Boards to quickly identify a suitable problem.

Centres are given clear advice on product analysis as part of the individual centre report. A generic recognition of similar products should be followed by a comparison of products, preferably with a disassembly of an existing product.

There continues to be a misconception with regards to looking at trends and patterns in existing products. This needs to be specific to the theme rather than generic about a product. Some candidates were too ambitious and looked at time lines for products such as televisions or computers. Very little information is gained from this, which can be used in the design of the prototype system.

Too many candidates failed to recognise the links between a quality product and the technology involved. It is essential in this unit to identify specific materials and specific technologies used in the manufacture and use of the product. Stating that a product is made from plastic or wood or metal, suggests a response of basic ability.

Most candidates consider the sustainability of a product. There were good examples of using the 6Rs when considering sustainability.

It is important that the research work should consider the control of the system used in the product.

Similar to last year, conclusions to the research continue to be lacking in detail and are often completed as an 'afterthought'. The conclusions need to bring all of the research activity together and form the basis for producing a detailed and justified Design Specification.

Successful Candidates:

- *Choose a theme.*
- *Create a 'mind map' to identify action points.*
- *Clearly identify the needs of the user and explain the situation in which the prototype could be used.*
- *Conduct detailed research – considering the changes in existing products, identifying trends, identifying specific materials and identifying the technologies used.*
- *Produce a comprehensive Design Brief and action plan for realising the brief.*
- *Conduct further research using critical analysis of a product to evaluate function and user needs and to consider specific material properties, sustainability, and product life cycle.*
- *Make specific reference to an 'Eco-Web', considering the sustainability of a product in detail.*
- *Make a summative evaluation of the research activity leading to conclusions, which will help form a Design Specification and final list of User Needs.*

Designing

The Design Specification continues to be a cause for concern. Good specification points should be justified and measurable. There should be clear evidence that the candidate has thought about controlling the proposed system. Some candidates wasted valuable time, writing long paragraphs for each specification point.

A justification can be made using the terms, 'because' or 'so that'.

The specification should be used throughout the design process in this unit, to ensure that the design meets the needs of the user. Some candidates produced a Design Specification that was too prescriptive or too vague to help with the design development.

In some cases, candidates described the **product** they were making before actually designing it. Candidates need to show their technical knowledge when adding system details.

It is good to see most centres using a Systems approach to starting the design process. This clearly shows a range of INPUT and OUTPUT devices. However, many candidates fail to recognise or identify a range of controlling devices.

Most candidates produce a range of ideas with detailed notes on the components used in each idea. A range of methods are used, including pencil drawings and the use of CAD programmes. In this section there should be clear evidence of how the design idea fits in with the need of the user. There should be clear reference to the Design Specification.

Design development continues to be one of the weaker aspects of the Unit. Most candidates undertake modelling to test their best idea. This is often a repeat of one idea to see if the circuit or mechanism works. Candidates should use this process to combine ideas, make modifications and suggest alternatives. Once again there should be reference to the need of the user and the Design Specification. There should be comments about the changes made to the original idea.

It was good to see candidates referencing circuit ideas, taken from books or internet sources. However, this unit allows the candidates to be creative, to modify and change ideas, in producing a prototype system. Candidates are expected to 'design' their own solution to a problem.

It was good to see that most candidates produced a final design following the modelling stage. Candidates should list the components and materials to be used in the making stage. There was good evidence of the components and parts required to make the prototype system.

Successful Candidates:

- *Produce a detailed, justified, measurable Design Specification, for a prototype system* ***not*** *a product. Please note that the term 'detailed' does not mean a paragraph on each individual point.*
- *Create a range of ideas with written explanations of how and why each idea could work.*
- *Make specific reference to the needs of the user and the specification.*
- *Select ideas for development and test these ideas to develop a final design using modelling.*
- *Modify original ideas to produce a final design for a prototype system.*
- *Show full details of the final design including materials, components and a consideration of size.*

Making

A detailed plan needs to be produced before the start of the making process. It was good to see that most candidates produced a plan. Candidates need to consider how they will include the control of the prototype system.

Generally, candidates produce high quality prototypes, either as a circuit or mechanism. Candidates are judged on the quality of the manufacturing.

Some candidates include generic sheets on health and safety, which simply add to the bulk of the folder/presentation when in fact health and safety should be relevant to the candidate's proposed design.

Successful Candidates:

- *Produce a plan that includes include specific reference to materials, processes, tools, equipment, health and safety and quality control. The plan should make reference to individual stages of production. 'Populating a PCB' is too generic.*
- *Show evidence that they have selected and used tools and equipment to construct, assemble and finish a working prototype.*
- *Manufacture a working prototype system.*
- *Use tools and equipment in a safe manner, producing accurate stages of manufacture.*
- *Emphasise the use of a control system for the prototype.*

Solving Technical Problems

Despite previous guidance to centres, this section continues to be over marked. Candidates are awarded full marks when there is little or no evidence in the folios.

A SNAG sheet should be presented, clearly indicating when and how the candidate solved problems during the manufacturing stage. In some cases the comments can be positive and reflect the high quality of manufacture 'because'……

Successful Candidates:

- *Link this section to the production plan, clearly indicating how they solved problems as the prototype is manufactured.*
- *Clearly show a SNAG page, highlighting the problems that occurred during manufacture of the prototype and giving clear evidence of how the problems were solved.*

Record Key Stages

It was clear this year that some candidates struggle to record all the stages of manufacture and present evidence of their work. It is appreciated that in centres with large numbers of candidates keeping track of photographs is difficult.

It was evident that in some centres, candidates presented images of two or more different circuits when evaluating the final prototype. This would suggest issues of malpractice *when it is likely* that candidates simply copied images from a shared area on the Internet.

It is essential that when marking the coursework, teachers fully check the authenticity of the work. There were excellent examples where the work was clearly accredited to the candidate at every stage of the manufacturing process.

Some centres awarded full marks when the evidence presented did not justify the award. Most centres produce photographic evidence of the manufacturing stages. It is important to describe the processes and techniques used. A photo diary on its own with no commentary will not justify full marks.

The comments should relate to the individual project. It is important that the photographs are of sufficient resolution to reflect the quality of work completed. When producing a PCB the photographs should show evidence of the quality of soldering and construction of the control system. The population of the PCB or assembly of a mechanism should be shown, stage by stage.

Successful Candidates:

- *Fully record all stages of manufacture, using photographs and notes. This includes evidence of producing a PCB and/or using CAD/CAM.*
- *Record all stages of PCB or mechanism manufacture, including photographs of PCB population, stage by stage.*
- *Show clear evidence of the Final Prototype in use, with photographs which clearly show the quality of manufacture including soldering and assembly.*

Critical Evaluation

Most centres now recognise that candidates should comment on the designing and making processes - only - in this unit. Many portfolios start with comments on the modelling stages, recording problems and changes. When recording the making stages candidates tend to highlight problems, rarely do candidates record stages that went well, despite evidence of high quality prototypes, high quality soldering and clear indication that the prototypes fully function.

Candidates do not need to evaluate the Design Specification in this unit. Some candidates wasted valuable time on this exercise, gaining no credit.

Simple testing is important to see if the system meets the original needs. Comments are then made for improvements in system functions, these are rarely completed in detail.

It would be useful if the centre added teacher comments about the success of the system.

Most folios were well presented in a logical order and the majority of centres awarded the correct mark for Spelling, Punctuation and Grammar.

Successful Candidates:

- *Produce a critical evaluation of the making process for the prototype system.*
- *Fully test the prototype and suggest improvements*
- *Present their work in a logical, structured format.*
- *Use the correct technical terms, using words accurately.*

A513 Making quality products

General Comments:

The vast majority of centres submitted the appropriate paper work on time, prior to the 15th May deadline. Centres are reminded that in this unit candidates design and manufacture a fully working product. There is greater emphasis on the manufacturing skills than in unit A511 – there was clear evidence of many completed products being tested in real life situations.

A513 continues to be a successful controlled assessment. The majority of this unit is completed in year eleven when candidates have fully developed their designing and manufacturing skills. Centres should be congratulated on the work shown for this unit.

It is good to see that more centres are working within the 20 hour limit for the controlled assessment.

The themes for A513 are set by OCR. Most centres introduce the controlled assessment via a Mind Map related to the choice of themes.

There were many outstanding projects submitted, with a range of 'Timers', 'Alarms' and 'Environmental' projects (related to light and sound).

There were very few entries submitted through the Repository this year. Most centres provided work completed on A3 or A4 paper. Centres are reminded that folders need to be bound appropriately with a cover sheet attached. The paper projects caused difficulty in some cases when the individual folders were not securely bound and sometimes fastened with paper clips, which inevitably link together when handling the folders.

An increasing number of centres are providing the work selected for moderation on a CD ROM or on a USB. Both methods are appropriate and save on printing costs, particularly colour printing. These methods allowed moderators to zoom in on photographs when moderating work and give a very clear, close up view, on the quality of the manufacturing.

To ensure candidates are given the best opportunity to achieve success, it is important to provide clear evidence of the manufacturing process – with photographs being in focus and preferably in colour. In a number of paper folders the photographs were very small, lacking in clarity and detail.

The information on the CD/USB also allows high quality video clips of the final product being tested. This is particularly beneficial in providing evidence that the circuit or mechanism works. Candidates are clearly proud of their achievements and showing fully functioning products, with short commentary on success and failure, is to be commended.

The completed products seen during the moderation process continue to be manufactured to a high standard.

Please note that some centres are relying on library circuits, either school based or from software, leading to whole centres of very similar products. When this happens it affects the creative aspect of the design process.

Specific Comments on:

Designing

Using a mind map is the best way to start investigating the theme. Candidates are reminded that this section should be concise and 'padding out' this section will gain no more than four marks.

There is no need to produce questionnaires or surveys for this unit. Product analysis could be used as a starting point but does not need to be in the same detail as A511. Candidates could look at an existing product and use the information gained as a starting point for the system and case/structure.

The design brief should clearly identify the need and problem to be solved.

Information and data needed is about the problem, user and/or client group.

When writing the specification, most candidates use a series of prescribed headings which often become a generic list, lacking in focus and not specific to the project being undertaken. Centres should encourage candidates to think more clearly about the function and meeting the needs of the user.

Similar to 2014 series, some candidates limit the designing section by being too prescriptive in the Design Specification – predetermining the materials and components to be used.
It is good to see that centres are using a system approach at the start of ideas, but centres must ensure that candidates then produce a range of full circuit ideas. Selection of designs/ideas is still poorly completed, with most reasons seemingly based on the ease of making the circuit or system rather than consideration of the user.

The majority of candidates undertake modelling either on a breadboard or virtually, via software. However, the modelling is used to test whether or not the final idea works, rather than using modelling as a development tool to modify, change and finalise the best design.

Candidates should be using modelling to develop and improve the initial ideas. Annotation should reflect the changes and modifications to be made.

The casing of a structure needs to be developed in the same way as the control system. There was good evidence of quality sketching with detailed annotation and reference to the specification.

Selection showed little relation to the needs of the user and this continues to be a weakness amongst the majority of candidates. Some candidates produced very creative design ideas for cases and then reverted to a plain rectangular box because it was easier to cut out, by hand or by CAD/CAM.

Candidates who achieved highly, created innovative cases/structures, together with creative circuits/mechanisms.

The use of CAD continues to develop and candidates are to be congratulated on the presentation of case/structure/mechanism designs. It is good to see the direct connection to manufacture where centres use laser cutters or a CNC router/miller.

Where centres use bought in cases, it is important that candidates show in detail how the box is being used. Fixing of the PCB, battery and cable routing must feature in the design work.

It is important that the case and circuit fit together to form a completed product.

Many photographs of completed products clearly show that the PCB and components fit the case.

When there is a lack of evidence with regards to the use of components relevant to the size of the case, the final product is incomplete and will not be awarded full marks. The final design should be shown, as the PCB mask or the mechanism layout, together with dimensioned details of the container or structure.

Most candidates produced the correct information to start manufacture.

Successful candidates:

- *Start from a THEME and identify a problem. This may include ergonomic data, illustrating the need and making reference to any important component/part.*
- *Produce a summary, which brings out the main points that must be considered.*
- *Clearly state the function and performance of the product in the design brief.*
- *Produce a list of Specification Points, which are measurable and related to the user/client, enabling them to be used in the evaluation.*
- *Appraise and develop creative ideas clearly linked to the specification and need.*
- *Select reasons based on user need (when modelling, the selected system is built and then improvements made to make it match the need of the user).*
- *Finalise the control system and the structure with clear details for making the product.*

Making

Most candidates produced plans including detail of materials, equipment, health and safety, quality control and time.

Candidates should consider the whole product and composition of the system, the structure/container and the assembly.

In some controlled assessments there was no plan evident, yet the product was incorrectly given full marks.

Candidates have been able to demonstrate good quality making, both in the control system and case/structure. In a small number of centres the PCB was a pre-manufactured item used by every candidate.

When there is no evidence of the designing or modification of a circuit, candidates cannot be awarded full marks. Assembling a pre made kit with perfectly drilled holes does not test the candidate's ability to manufacture a quality product. It is simply an assembly exercise.

Centres are reminded that candidates are awarded marks for producing PCBs. Candidates are judged on the quality of soldering including the number of scorch marks and use of wires to complete the circuit. Candidates can gain marks in the next section by suggesting how they solved problems during the manufacture, however, poorly designed and manufactured circuits, which clearly don't work, will not gain access to the higher marks available.

Solving Technical Problems

It is expected that modifications and changes will be made during the making stages and these should be recorded in writing with reasons for the change. This section can include more than just things that go wrong. I repeat my comment from last year that centres must not assume because the product is successful they can award the highest marks. Evidence must be presented to justify any mark given.

Often candidates hide problem solving comments in the evaluation section.

The use of a SNAG table or sheet is required at this stage.

Record Key Stages

This section continues to improve and most candidates are proud to display images of how they made the product. Candidate labels should be more evident to ensure the images are unique. It is good to use library images for the start of the project when manufacturing a PCB, but care should be taken to show the real work of candidates when assembling the control system.

Where centres link the recording with the production planning chart, care must be taken to ensure that planning and evaluation are completed separately, before and after making.

Successful candidates:

- *Include a production planning chart which breaks down the stages of manufacturing the control system and the case or structure, then shows the assembly stages through to final testing. The chart records materials, equipment, quality control points and expected time.*
- *Use a range of construction methods, using their own skill for a high quality product.*
- *Make and record changes and modifications to ensure the product matches the needs of the user/client. The candidate records all the changes of both manufacture and any reworking that is necessary.*
- *Demonstrate solving technical problems with a written log.*
- *Record the key stages of manufacture, using a set of detailed pictures with comments of the stages, showing the testing with the product working, in an appropriate situation, linked to the user.*

The use of short video clips is to be recommended.

Critical Evaluation

Most candidates use the specification when looking at the final product. This comparison works well when the specification is written as measurable points for the performance of the product. Writing generic descriptions of performance makes evaluation more difficult and less effective.

Adding ‘achieved’ or ‘yes’ to the specification point does not justify the success.
A good example would be: “The appearance of my final product was very successful because of …….colour, finish, quality of materials etc.”

Using members of the user group for testing the product can give good feedback when the group makes constructive comments.

Effective testing should be recorded to show the performance, and this is where short video clips are useful. When matching the product’s outcome to the user need, real points of modification and improvement arise.

Successful candidates:

- *Write critical points when comparing the specification to the final product.*
- *Test the final product to show clearly how the product works for the user group and to bring out points where the prototype needs modifications and changes.*
- *Use sketches and notes to show how the second prototype will be different and improved.*
- *Organise the folders and use specialist terms appropriately and correctly.*

A515-01 Sustainability and technical aspects of designing and making – Electronics Paper

General Comments:

It was pleasing to see that there were only a small number of 'no response' answers which were linked to specific questions, similarly there were very few candidates who failed to complete the paper fully. Pleasingly, there were noticeable improvements across the range of responses including those achieving the highest marks.

It is important to stress that questions must be read fully before an attempt is made to respond. This is particularly important with the '*' questions which test the quality of written communication. If the question is misinterpreted a lot of marks can be lost. There were very few instances of 'bullet point' lists or repeated points within these questions this year which was pleasing. This year there were a significant number of candidates who repeated the question stem at length as part of their answer, especially on the '6 mark' written responses. Candidates may have been told to try and fill the space, but it should be understood that there are never any marks awarded for repeating the initial question as part of an answer on any of the questions on the paper.

Where a question requires candidates to sketch as part of their response, those candidates who were most successful made full use of the space available so that sketches were clear. It is important that candidates use clear annotation and provide sufficient detail in their sketch and annotation to allow the examiner to give credit for the understanding shown.

It is also important that candidates take care to ensure their answers are legible to the examiner, and that they do not put themselves at a disadvantage if credit cannot be given because the response could not be read.

If candidates use the additional space at the back of the paper or in a space not intended for a response to all or part of a question it is vital that the response is clearly labelled with the question and part number. It is also a good idea to put a note in the correct response space for the question part, indicating to the examiner where the additional work has been carried out.

Candidates demonstrated through their answers in Section A, a good general knowledge and understanding of sustainability issues. However, some candidates did not seem to have the knowledge to respond to questions relating to the 6 'Rs' and in particular the differences between primary, secondary and tertiary recycling.

Knowledge of commercial practice is an area of weakness demonstrated by many candidates through their answers, this knowledge can best be gained from the disassembly of electronic products. Candidates who had carried out this type of work were clearly better equipped to answer the questions which covered design features, information now found on electronic products and understanding of manufacturing techniques such as injection moulding.

Knowledge of certain components and their use in circuits is an area of weakness in candidates knowledge and understanding. Candidates need to understand fully the use of op-amps and PICs in circuits alongside more commonly used and understood components.

Comments on Individual Questions:

Section A

Questions 1-15 consisted of 1 mark responses and they were, generally, well answered with very few nil responses.

Q1 Most candidates correctly identified that to reduce your carbon footprint when recharging a battery you should charge it from a solar electric panel.

Q2 Most candidates recognised that some smart materials change their properties when heated.

Q3 Again almost all candidates recognised that solar panels harvest energy from the sun.

Q4 The majority of candidates answered this question correctly, where candidates demonstrated a lack of knowledge they thought that coal fired power stations can contribute to volcanic ash clouds.

Q5 Most candidates answered this question correctly showing a good understanding that reducing the use of chemicals dangerous to the environment can contribute to preserving the world's eco systems.

Q6 Answers to this question were mixed with many candidates lacking knowledge as to the definition of RoHS. The most common error included the use of the word 'Harmful' incorrectly instead of 'Hazardous' or 'Health and Safety' as an incorrect answer.

Q7 This question was well answered with common responses including 'the sun' and 'wind' power.

Q8 Answers to this question were mixed with some candidates showing a good understanding of the contribution of excessive carbon dioxide to 'global warming'. Where candidates showed a lack of understanding they frequently stated that 'carbon dioxide produced acid rain' or that 'it can damage the ozone layer'.

Q9 Many candidates correctly identified that a biodegradable product will degrade or rot down naturally. Where candidates failed to gain the mark, answers were too general talking about 'it can be broken down' with key terms such as 'degrade' or 'naturally' missing.

Q10 Many candidates got this correct identifying that 'Recycling' or 'Recycle' described the disassembly and reprocessing of materials for use in new products. Some candidates showed a gap in their knowledge suggesting that this meant 'Reuse'.

Q11 All candidates correctly identified that globalised companies do not only sell their products in the United Kingdom.

Q12 Most candidates identified that all redundant products should not be sent to landfill.

Q13 Some candidates correctly identified that designers of mobile phones include built-in obsolescence, however many did not think this was true and this is an area that needs further understanding by candidates.

Q14 Most candidates identified that leaving television on standby wastes energy.

Q15 Some candidates demonstrated a good understanding of WEEE regulations. There were a small number who failed to understand that WEEE regulations help with the safe disposal of faulty electronic products.

Q16(a) This question was well answered with the majority of candidates gaining 3 marks and only a small minority failing to gain any marks. Common answers identified the winding handle; on/off switch; speaker grill; and aerial. Where candidates failed to gain credit their answers were too general and not linked to a design feature of the wind-up radio, for example 'box shape'.

Q16(b) Only a small number of candidates gained a mark on this question by recognising the purpose of the rechargeable battery in the wind up radio. Those candidates who gained a mark commonly identified that the rechargeable battery meant you did not need to keep winding the radio all of the time. The common incorrect answer referenced 'the battery not needing to be replaced as it can be charged again'.

Q16(c) Most candidates gained at least a mark for this question. Common answers identified that the radio being easy to dismantle with the small cross-point screwdriver was beneficial to the environment 'due to the radio being easier to repair', similarly 'it could be taken apart for recycling of the case and components'. Not many candidates answered with reference to the dismantling being quicker or the battery being disposed of safely.

Q16(d) Most candidates gained at least 2 marks for this question. The majority of candidates were able to identify that the electronic components would be removed, tested and reused. Most commonly candidates failed to recognise that thermosetting plastics would be ground up and used as filler.

Q16(e) This question showed a lack of understanding of the different types of recycling. Common correct answers referenced 'giving the radio to a charity shop' or 'selling it on ebay'. Common wrong answers talked about 'taking the radio apart and recycling the case and components' or 'taking it to a specialist recycling centre'.

Q16(f) This question was answered well. Common annotated sketches included reference to winding the radio up using the handle; extending the aerial; switching the radio on and tuning using the dial. Where candidates did not gain full marks this was generally because they did not cover sufficient points, for example only talking about winding the handle even though this was explained in great detail.

Q16(g) Candidates answers were generally well written with the more obvious points identified as to how wind-up electronic products could improve the day-to-day lives of people in less developed countries. Common points made included lack of access to electricity and where electricity was available a lack of money to use this. Points made also included the opportunity to access entertainment by having the radio and to listen to the news therefore gaining a greater understanding of what was going on in their country. Higher scoring candidates identified the use of the radio to communicate with people about potential emergencies or disasters. Many candidates used product examples such as wind up torches and laptops as well as the radio to explain how wind up products could be beneficial to people in these countries.

Section B

Q17(a)(i) This question was well answered with most candidates gaining full marks. A small minority of candidates failed to identify the 'motor' correctly. Candidates need to be careful not to confuse 'cell' with 'battery'.

Q17(a)(ii) Most candidates gained at least 1 mark on this question, the most common answer identified the visible ejector pin marks, although to gain the mark candidates tended to describe the 'circles' that were visible and did not link these to the ejector pins. Those candidates who gained the second mark tended to refer to labelling for the battery orientation and type as being part of the internal moulding or identified the built in webs for stiffness and battery location.

Q17(a)(iii) Only a small number of candidates correctly identified 'ergonomics' as the area of design that had not been fully considered. Candidates tended to incorrectly identify 'aesthetics' from the options available.

Q17(a)(iv) Only a small number of candidates identified that the batteries were connected in 'Series'. Surprisingly, candidate answers showed little understanding of this basic concept.

Q17(b)(i) Those candidates who gained a mark on this question tended to identify the use of the relay where the control circuit and motor circuit voltages differed. Where candidates showed a lack of understanding they tended to suggest incorrectly that the relay could switch the motor on and off faster or smoother.

Q17(b)(ii) Some candidates correctly identified the voltages on points X and Y on the relay connections. Where this was answered incorrectly candidates tended to identify the voltage as less than 6V, dividing it down into lower values.

Q17(b)(iii) Very few candidates gained marks for this question showing a lack of understanding of motor circuits and how the circuit can be configured to run the motor in reverse, in particular that the motor terminals needed to be connected to X and Y for the motor direction to be changed.

Q17(c)(i) Those candidates who were awarded marks correctly identified the resistor (R1) as limiting the current into the transistor, very few candidates identified the purpose of the Diode (D1) as preventing transistor damage through back emf. Answers given by candidates that were not worthy of credit showed general understanding of the purpose of a resistor and diode but did not link this to the purpose of R1 and D1 in Fig. 5. Some candidates mistook the diode for an LED and their answers referred to the use of an LED in the circuit.

Q17(c)(ii) Most candidates scored at least 1 mark on this question. Common answers referred to the cost being very little more for the Darlington Array when compared to the cost of the same number of single transistors or Darlington transistors. Others correctly identified that the base resistors were included, a further common answer identified the potential space saved by the Darlington Array when compared to individual transistors and resistors. Some candidates correctly identified the cost saving but failed to link this as being only of use if you required the additional Darlington transistors.

Q18(a)(i) Some candidates correctly calculated the range of output voltages for the voltage regulator, although many failed to identify the output voltage from the data table and instead calculated 4% of 7805. Candidates need to ensure they read the question carefully and use the data available to them to answer the question.

Q18(a)(ii) The majority of candidates scored 2 or more marks for this question. Most candidates correctly connected Com to the 0V rail, and many managed to connect Pin 8 (0V) to the 0V rail. Candidates commonly incorrectly connected V_{out} to Pin 2 (Serial in) on the PIC instead of connecting it to Pin 1 (+V). Many candidates whilst correctly connecting the +9V rail to V_{in} then incorrectly connected it to the 0V rail so were unable to gain credit for this connection.

Q18(a)(iii) This question was well answered by candidates.

Q18(b) Some candidates identified that Pad C was the most suitable pad option, those candidates who answered this correctly explained that there was enough copper to solder to without joining the legs. Many candidates incorrectly focused on the spacing between the legs on the voltage regulator.

Q18(c) Where the small minority of candidates gained marks for this question it was for correctly referencing 'smoothing the voltage'. A number of candidates failed to even attempt this question.

Q18(d) Candidates answers were largely well written with clear use of punctuation, spelling and grammar. Most candidates focused on the importance of PPE including the correct use of guards where appropriate on machines. There was also a focus on the importance of training users in the use of machines and hand tools. Candidates who were awarded the Level 3 band for their answers made reference to accident procedures and identified how risk could be assessed and control measures put in place to manage and reduce this risk.

Q19(a) There was a lack of understanding on this question of how the resistance changes in each sensor as the light and temperature level changes, with most candidates unable to represent this graphically. Many candidates drew the graphs the wrong way round.

Q19(b)(i) A small number of candidates answered this question correctly by accurately identifying the connections on the op-amp comparator, indicating this as an area of weakness in candidates' knowledge and understanding.

Q19(b)(ii) Very few candidates were able to explain how the op-amp comparator output is decided.

Q19(b)(iii) The majority of candidates gained full marks on this question.

Q19(c)(i) Common correct answers included the use of screw terminals, with some candidates using spade fixings. Where candidates answered this incorrectly they talked about the use of strain relief holes on permanent soldered connections or soldering and then de-soldering.

Q19(c)(ii) Only a small number of candidates correctly identified the NOR gate from the truth table.

Q19(d) Generally candidates gained full marks or no marks for this question. A few candidates correctly identified the output logic levels for switching the red and green LED on but then wrote the inverse for the yellow LED (the logic levels for switching it off) meaning they only gained 2 marks out of the 3 available.

A515-03 Sustainability and technical aspects of designing and making – Mechanisms Paper

General Comments:

A good number of entries this June saw the continued trend of well-prepared candidates able to access the full mark range. There were noticeable improvements across the range of responses including those achieving the highest marks. There was no evidence of candidates running out of time, with the majority attempting all the questions with varying degrees of success. There was evidence of a good technical vocabulary, but in a significant number of cases it was incorrectly applied or used. The abbreviation for RoHS was very well answered.

This year there was a veritable epidemic of candidates repeating the question stem, especially on the 6-mark written responses or if several lines were available for their answer. They have perhaps been told to try and fill the space, but there are never any marks for repeating the initial question.

The ability of candidates to write legibly by hand seems to be steadily declining; they put themselves at a very real disadvantage if their response cannot be read.

Comments on Individual Questions:

Section A

Questions 1-15 consisted of 1-mark responses and they were, generally, well answered with very few nil response.

1 Generally well answered, although a surprising number of candidates believed that charging from a mains socket would qualify.
2 Smart materials that respond to heat were well known.
3 All candidates were able to identify the sun as the source of solar energy.
4 Well answered, although a significant number thought that coal fired power stations contributed to volcanic ash clouds.
5 Reducing the use of dangerous chemicals was well understood.
6 It was noticeable that this year the full meaning of RoHS was well known and remarkably well spelt.
7 Sources of renewable energy were well known with solar or wind proving popular.
8 A significant number of candidates believed that CO2 was responsible for damaging the ozone layer, the loss of which then somehow contributed to global warming.
9 The natural degradation or decomposition by natural means resulting in nothing toxic was well answered.
10 Recycling was generally chosen as the correct 6R, although reuse was a popular answer in second place.

Q11- 15 were well answered; a noticeable improvement on previous years.

Questions 16 (Section A) and 17 -19 (Section B) involved a variety of 1,2,3,4 and 6 mark part questions. Question 16 focussed on sustainable design, whilst questions 17-19 focussed on mechanisms.

16a This was well answered by the majority with the most common failing being listing desirable design specification points rather than features of the existing radio as requested.

16b The best answers included mention of the fact that energy generated (by solar or wind-up) could be stored and used later. Environmental benefits of not buying batteries or their subsequent disposal did not score marks.

16c A wide range of benefits were identified by candidates including the lack of electricity needed to power any tools or the need to mine raw materials to make them in the first place.

16d Most candidates scored 2 or more marks. Some believed that thermosetting plastics could be melted down although most correctly identified the remove, test and re-use for electronic components.

16e Primary recycling was very often miss-read and any recycling was then offered as an answer. What was specifically required was the gifting/donation or sale of the product as-is.

16f The majority of candidates were able to draw and describe a variety of operations on the radio with winding it up, pulling out or directing the aerial and switching it on/tuning it in being popular.

16g This was well-answered with many candidates expanding on the wind-up concept to include a torch or lighting and television with information about how lives and education would be improved by wind-up products. Some were more ambitious, suggesting that cooking could be accomplished by similar means. Legibility remains a concern, including that of one script apparently completed by a scribe.

Section B

17a Most candidates were able to correctly identify the classes of lever used. There was evidence of simple sketches being used to aid memory recall.

17b The position of Load, Effort and Fulcrum were well-identified, sometimes on both presses.

17c Speed and permanence of assembly were popular solutions, along with a variety of incorrect suggestions such as ‘allows dismantling’.

17d The knowledge of plated finishes was very poor. It seems that the majority of candidates simply chose a metal from which the handle could have been made. Nickle and chrome were the only answers seen that gained marks. The study of simple domestic appliances would offer a variety of learning opportunities for candidates here.

17ei Polystyrene was not often suggested, whilst almost every other thermoplastic was though, including PTFE.

17eii Although known by some, injection moulding was not as frequent an answer as it perhaps should have been.

17eiii The suitability of acrylic for modelling mechanisms with its availability and ease of e.g. laser cutting was not as well-known as expected.

17f The majority of candidates scored well on this question, drawing a range of feasible solutions (worm and wheel, twisted belt, bevel gears, compound gear train). Over-complication or attempted use of recalled but unsuitable mechanisms (cams) led to lost marks, as did putting the worm on the windmill shaft, expecting the handle to then be able to turn. A brief study of a tennis net tensioning device would convince them otherwise.

18ai V belts are not as well known as they used to be, despite their presence on almost all workshop-drilling machines.

18aii Pulley Q was universally identified as running the fastest.

18aiii Very few candidates were able to correctly explain the purpose of the flywheel. A significant number believed the 'motor' would keep it going if the engine failed.

18b Generally answered correctly with reference to improved efficiency/less loss, fewer parts needed or lower maintenance requirements. Some attempts at re-phrasing the same content to sound different was evident in response to this question.

18c This question was very poorly answered by the majority of candidates. Many scored two marks for reference to the composites being lighter and so saving fuel in cars and aeroplanes. Composites were variously ascribed bogus properties; most worrying was that they 'would not protect you in a crash'. As the quality of answer improved, mention was made of the difficulty of recycling composites, corrosion issues with metals and the self-finishing benefits of composites.

19ai A good percentage of candidates were able to choose the correct numbers and achieved two marks. Although not specifically labelled as driven and driver, a study of mechanisms should engender some understanding of the point of a gearing system and therefore which way round a driven/driver pair would function in any given situation.

19aii A correct answer in 19ai usually produced a correct answer in this question. The actual number of teeth was indicated on the figure to assist candidates with this.

19aiii Those who referred to risks to operators received the mark here. Other answers included corrosion; dust; jamming; subsequent explosion of parts and in one case theft, presumably triggered by 'un-guarded'.

19aiv Most candidates scored at least 1 mark, the best answers simply stated 'a reduction of speed coupled with an increase in torque'. Weaker candidates contravened the laws of thermodynamics by stating that an increase in energy occurred.

19bi. Very few candidates identified the grease nipple, possibly reflecting their relative rarity on modern machinery.

19bii A greater number were able to give a legitimate reason for the use of a temporary fitting, although few suggested that only simple tools would be needed to extract it and service this part.

19biii The vast majority were able to cite rust or corrosion as problems for bare cast iron.

19ci Very few candidates were able to identify part X as a connecting rod, although most made an inspired guess.

19cii Most candidates were able to manage 'rotary' and 'crank' or 'crankshaft', although a number managed other words that began with R and C that may have been learnt along the way, e.g. rod and cam.

19ciii A very small number of candidates were able to explain the nature of and suitability of a sintered bronze bush.

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