OCR
RECOGNISING ACHIEVEMENT

GCSE

Design and Technology: Electronic and Control systems

General Certificate of Secondary Education **J301**

General Certificate of Secondary Education (Short Course) **J041**

OCR Report to Centres

June 2013

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support, which keep pace with the changing needs of today's society.

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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OCR REPORT TO CENTRES

Overview

This report provides an overview of the work seen in the written examination Units 2 and 4 and the Controlled Assessment Units 1 and 3, for candidates who took the examination during this series. It precedes a more detailed 'Report to Centres' from each subject area within the Innovator Suite and highlights general issues that have occurred across the suite of specifications. This is the fourth year of the Innovator Suite.

This report has been prepared by the Chief Examiner, Assistant Chief Examiners, Principal Examiners and Principal Moderators and covers all specifications within the Innovator Suite. It should be read in conjunction with the examination papers, the mark schemes, and the marking criteria for assessment given in the specification booklets.

Centres are reminded that it is also an Ofqual requirement that candidates are now credited for their accurate use of spelling, punctuation and grammar across all four units.

Written Examinations – Units 2 and 4

Unit 2

For this examination series of the GCSE Innovator suite entries were seen from all six subject specialisms.

The overall performance and range of results for Unit 2 was generally the same as seen in the January 2013 series. There are variations within the subject specialisms and Centres would benefit from reading the individual subject reports for this unit.

It was pleasing to see that many candidates had been well prepared for the examination by Centres and clearly had a sufficient knowledge base to answer the questions. It has been encouraging to see that candidates have been able to access the higher marks. There was also a significant improvement in the extended response style question* this series, with candidates giving detailed answers combining good subject knowledge with an ability to produce a structured response.

In **Section A** of the papers most candidates across the suite attempted to answer all questions, with few candidates giving no response (NR), although these do still occur. Candidates should be encouraged to attempt these types of questions if unsure, rather than giving no response at all.

Candidates generally demonstrated an improved understanding of sustainable design, but were often still hampered by their exam technique. Misunderstanding or misinterpreting the question, or not reading the question carefully enough was evident throughout the suite of papers. Candidates must be encouraged to take notice of the key word in the stem of the question to identify whether the question requires them to explain, describe, discuss, state, name or give.

There was less duplication of answers seen during this examination session, although one area of concern is that of the 'scattergun' approach to answering questions. Candidates need to be aware that where one answer is asked for and multiple answers are given by the candidate, candidates will lose the mark for the correct answer if an incorrect answer is also given. Some candidates approached these questions by supplying multiple answers, writing everything they can think of about the subject. Examiners cannot credit the one correct response out of several provided in a question which explicitly asks for '**one** reason' or '**one** example' because the candidate has not adhered to what has been asked for. It would be unfair on other candidates who had several possible answers in mind but addressed the question and selected their one final answer to provide rather than 'hedging their bets'.

Section B of the papers showed a greater range of responses in terms of quality and teachers need to ensure they read the subject specific reports for further detailed feedback on specific issues and individual question performance.

Candidates need to be careful that they do not repeat the question in their answer or repeat the same point within their answers.

The questions marked with an asterisk * provided candidates with an opportunity to give a detailed written answer combining good subject knowledge with an ability to produce a structured response. Many candidates did manage to use subject specific terms in their answers, but at times lacked sufficient depth and tended to be repetitive which compromised marks.

Hand writing at times was difficult to decipher and candidates need to do everything possible to ensure that their writing is legible. Centres are reminded that candidates are marked on spelling, punctuation and grammar on this question.

It was noticeable that where extra paper was required to continue a question response, many candidates did not reference the question number on the extra sheets used. It is important that Centres instruct candidates how to highlight where they are continuing an answer on a different page in the examination script to ensure that examiners are clear where an answer continues on a separate page in order that the candidate's full response is considered.

Centres need to be aware that questions may appear on the back page of the examination document and candidates should be encouraged to check carefully that they have completed ALL questions.

Unit 4

For this examination series of the Innovator suite entries were seen from all six subject specialisms. The overall performance of candidates was varied across the suite once again this series.

Some key areas which Principal Examiners have highlighted as giving scope for improvement are as follows:

- Candidates should attempt every question.
- It is important that candidates read the questions carefully to determine exactly what is required before attempting an answer. It can be helpful for candidates to highlight what they consider to be the 'key' words or instructions.
- In those questions that require candidates to produce sketches and notes, it is essential that answers are made as clear, detailed and technically accurate as possible.
- There were many instances where examiners were unable to decipher illegible handwriting and poor quality sketches.

Controlled Assessment

Units 1 and 3

Most Centres have been prompt in the dispatch of documentation to OCR and moderators, which is to be commended. **It is important that Centres return the portfolios to the moderator within three days of receiving the sample request.**

Centres are reminded to forward form CCS160 to moderators. It is helpful if Centres also include a record of the marks allocated to each candidate for each of the marking criteria sections.

Candidates producing paper portfolios should be entered for postal (02) moderation. Candidates producing their portfolio on a CD or memory stick should also be entered for postal (02) moderation.

Centres must ensure that if candidates are entered through the repository (01), the portfolios must be uploaded via Interchange and **NOT** sent through to the moderator on a disc. The preferred format of files presented for this type of moderation needs to be PowerPoint, PDF or Word, with work saved in ONE file only and numbered, not as individual sheets saved as different files.

Portfolios should be clearly labelled with the Candidate and Centre name and number, with the unit code and title also evident. (*Specification - 5.3.5 Presentation of work)* This is particularly important when the Centre submits work via the OCR Repository, where individual files are used to store portfolio work. Centres must ensure that candidates clearly label each file using the marking criteria section headings; this facilitates a more effective completion of the moderation process.

Centres are also reminded to ensure that the OCR cover sheet is included with each portfolio of work, outlining the theme and the starting point chosen by the candidate.

JCQ documentation on Controlled Assessment (September 2011 – August 2012) clearly states that any guidance given to candidates must be clearly recorded. *4.5.2 When marking the work, teachers/assessors **must not** give credit in regard to any additional assistance given to candidates beyond that which is described in the specification and **must** give details of any additional assistance on the appropriate record form(s).**This includes providing writing frames specific to the task.** (e.g. outlines, paragraph headings or section headings).*

In light of the information given above, Centres need to take care when using writing frames in the controlled assessment portfolios.

Many candidates included a bibliography or referenced their research sources, which was pleasing to see. **It is good practice to ensure that candidates acknowledge sources of information used for the development of their portfolio work**. *5.3.2 Definitions of the Controls* section in the specification states: *"The teacher must be able to authenticate the work and insist on acknowledgement and referencing of any sources used".*

Centres are to be reminded that the '*controlled assessment task must NOT be used as practice material and then as the actual live assessment material. Centres should devise their own practice material using the OCR specimen controlled assessment task as guidance.*' *Specification - Section 5.2.2 Using Controlled Assessment Tasks.*

It is a requirement in the Making criteria that candidates *"demonstrate an understanding and ability in solving technical problems".* **Centres must therefore ensure that problems encountered are written into the record of making, for the higher marks.** Marks were compromised here this examination series.

4.1 'Schemes of Assessment' clearly states that *"A Minimum of two digital images/photographs of the final product showing front and back views"* should be evident in the candidate portfolio. **It is the Centre's responsibility to ensure that photographs are evident, are of a good quality and are of the candidate's own work**.

A511 Introduction to Designing and Making

General comments

Centres have now worked out the most successful methods of approaching this unit. Candidate work is much more closely focussed towards the assessment criteria, therefore making more efficient use of their time. It is good to see some candidates handling components when developing the circuit on a breadboard. There has been a general lowering of specific control knowledge shown this series when describing circuit ideas. Some centres are still making a product, including the case/container, instead of a prototype.

Creativity

Most Centres were able to link to the set themes and develop areas of interest through a mind map. Many candidates used mood boards to illustrate their thinking around the theme; it is useful to have comments about the images. User needs and wants are sometimes more specifically shown when a group is identified. Fewer irrelevant questionnaires and surveys were seen this series.

Existing products were found by candidates on the internet. The level of comment was variable from simple descriptions and web-based information to looking at the products in detail for the technology used. Any points of good design and how the product has changed over time should be analysed for the higher marks.

The design brief was stated as a problem to be solved in most cases, at other times a range of solutions was discussed. Rarely was the situation discussed to set the scene for the design work.
Using products first hand for analysis is still an area of weakness in much of the work produced. Consideration of sustainability is often cursory and does not consider the impact of manufacturing and disposal of the product. A life cycle analysis for a selected product would enable disassembly and a full consideration of sustainability.
A conclusion of all the research data and information was rarely seen this series, which is a pity since it would help with a more focussed specification.

Successful candidates

- Showed good information about the user, the situation and needs. Primary research was used to identify ‘wants’. The technology used and design trends were clearly shown in similar products.
- Conducted a good product analysis using disassembly to identify relevant features
- Used an eco web to consider sustainability and its impact
- Produced a detailed conclusion to take forward and use to produce a detailed Specification.

Designing

Most candidates produced a lengthy specification and on some occasions these contained too many specification points to be realistic. The focus was often too generic rather than specific to the task. The design specification should be measurable and justified to enable successful evaluation to take place.

Weaker candidates fully listed what they would include, before designing, limiting the creativity aspect of the prototype design. Care needs to be taken in this regard.

The use of library circuits was very evident and often not acknowledged. Candidates should use control system terms when looking at design idea proposals. Often there is only a description of the components used rather than function comments.

Selection of the ideas is often not completed well; consideration of the user is rarely seen. Comments should talk about the function and the needs of the user and not just consider component availability as a means of selection.

The use of virtual modelling can lead to design problems when candidates do not understand circuits or faults shown. Improvements in the final idea tend not to take place, which is a pity since changes to match the requirements are always needed.

Final design details are completed well, mainly with CAD processing. The PCB tracking and mask tends to automatically be done but leaving a number of jump wires. Candidates should further process the tracking to remove the wire links. Many centres are remembering to put on the circuit board cable clamps for the additional wire connections.

Mechanisms design is also benefitting from use of CAD with linkages and gears. Most designs lead directly to laser cut components. Certainly the fast reworking of incorrect parts is an advantage. In most folders it is very clear what is to be made and the section is completed with components lists.

Successful candidates:

- Produced a detailed and justified specification, which they used to evaluate their ideas.
- Started with a system diagram clearly showing Input, Process, Output.
- Used a range of circuits/systems and added detailed explanatory notes
- Modelled their ideas using CAD or breadboard to develop the best solution.
- Considered the user in justifying choice/selection.
- Produced a final design which clearly showed consideration of the control device and considered size.
- Thoroughly produced evidence of development and selection.
- Listed components required for the manufacture of the prototype.

Making

Construction plans tended to be rather light on the detail of assembling the PCB with components. Most plans listed stages, materials and selection of tools.
Some centres award full/high marks because a prototype has been completed and works. Marks are awarded for the quality of PCB population and quality of soldering. Some centres had awarded full marks when there was clear evidence of scorch marks/poor quality soldering. These processes of production are an ideal way for candidates to show how they solved technical problems.

On the whole the quality of the finished product has continued to increase. Clearly centres and candidates are finding satisfaction from the completion of a good quality prototype system.

Solving Technical Problems

There is still a concern that some candidates show no explicit evidence of how they solved technical problems and complete this task as an afterthought. This section is often over-marked by centres, awarding marks when there is little written evidence to justify the mark awarded. Often the solving of technical problems is implied, with occasional references to it in other sections of the work produced.

It is advisable that centres set out to record this information as a snag sheet unique to the candidate, which is completed alongside the construction activity.

Record Key Stages

There was a slight improvement in this section and most centres completed this section using more photographs than seen previously. Some candidates did not put any notes with the photographs, which made the evidence less clear.

Although in some centres where candidate labels have been made, a unique set of photographs have been produced, we are seeing too much reliance on library images for the whole making process. It is important that candidates show their stages in making the prototype so that marks are not compromised. This photographic record helps moderators to judge the quality of the finished item and therefore better supports the marks awarded by the Centre.

Successful candidates:

- Produced a detailed plan for manufacture listing H&S, QC, Stages of manufacture and timing the whole process.
- Completed a prototype product using a range of construction techniques and demonstrated quality in the assembly stages.
- Provided a 'snag sheet' as a working diary to show how they solved technical problems.
- Produced detailed commentary with photographic evidence on the recording of key stages.

Critical Evaluation

This is often the weakest section where candidates seem to run out of ideas. Some candidates spend time by evaluating against the specification, which is not a requirement of this unit. Where candidates do look at the modelling and making stages some good comments are made, although there were some instances of one generic response across whole cohorts being provided.

Centres can create a means of completing this section by making sure candidates carry out appraisals of the modelling, looking for improvements in performance. Appraisal of the making stages can lead on from the problems they have solved and inform how to make the next prototype to an improved standard.

It is important that candidates test their prototype circuit/system and suggest improvements for future development; these proposed changes should be more than just different components.

Successful candidates:

- Produced a thorough review of the designing/making process, evaluating the success and failure involved in both.
- Tested the prototype showing the performance and how it met the needs of the user, suggesting modifications for future development.

Overall, the portfolios were usually presented as a power-point and showed good organisational skills and use of SPaG.

A512 Sustainable Design

General comments

This June continued the recent trend of well-prepared candidates able to access the full mark range on the paper. 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. Surprisingly there was a slight increase in candidates offering no response.

Question 6 asked for the full meaning of the abbreviation CFC and it produced some inspired but incorrect responses. It was disappointing to note that very few candidates knew the correct answer to solar panel orientation in the UK. There was a noticeable increase in candidates repeating the question stem, especially if several lines were available for their answer. A growing concern is the legibility of some candidates' handwriting; they put themselves at a very real risk of disadvantage if the response cannot be read by the examiner marking the paper.

The design question which was about an LED-based desk lamp produced a wide range of responses some of which were really very well drawn, annotated and thought out. Finally, after recent improvements, some candidates' choice of pen caused bleed-through the paper which affected the clarity of answers for those marking them in some cases.

Questions 1-15 (Section A) consisted of 1-mark responses and they were, generally, well answered with a few nil response.

1. Turning down a room thermostat: b; was well answered.
2. Solar panel orientation: d ; a poor response.
3. Purpose of Freecycle: a ; was well understood
4. Eco-design: c; the majority answered correctly.
5. Tertiary recycling: d; was generally chosen although a number chose 're-using the material three times'.
6. The full meaning of CFC was not well known.
7. The majority of candidates scored this mark giving a sound answer.
8. A fair number of candidates were able to offer a valid explanation.
9. A good number were able to recall either anthropometric or ergonomic, and some could even spell it.
10. A number of candidates listed the 6Rs and then eliminated others before picking the generally correct one.

Q11- 15 were well answered although weaker candidates struggled with 15 – British Safety Insulation.

Questions 16-18 involved a variety of 1,2,3,4 and 6 mark part questions.

16(a) was well answered by the majority. There was, however, a noticeable trend towards repetition, often subtly phrased in an attempt to convincingly fill the space or provide a fourth answer.

16(b) the environmental benefits of upgrading via the internet proved difficult for some candidates.

16(c) Designer data for phone holder was well answered.

16(d) Reduction in battery life was well understood with continuous screen illumination, data transmission/reception and satellite reception being cited as the major contributors. A number of candidates implied that the phone communicated with the GPS satellites.

16(e) phone charging with a solar cell was the most common answer, possibly supported by the recent availability of such products in the shops.

16(f) 'hands free voice control' of a phone was understood although some did struggle to make the connections to road safety. A number confused 'voice control' of a mobile with 'spoken' directions given by a sat nav.

17(a) The benefits to the UK of manufacturing in China was well understood.
17(b)(i) Globalisation was a difficult concept but most made an attempt at an explanation.
17(b)(ii) Advantage and disadvantage of globalisation brought some creative answers but candidates who had thought about it gained marks.
17(c) Design of the desk lamp with given components was well answered although most sketches were poor with drawing skills seemingly weaker than in previous years. A small number of sketches/designs were, however, excellent.
17(d) Consideration of energy during manufacture and use of the product brought some disappointing answers. Many candidates answered another question related to the environment with few focusing on energy. Most candidates did recognise the needs of the consumer to save energy with switching products off, but the connections to the manufacture of an electronic product was poor. A large number used up valuable time by writing out the given question 'Manufacturers and users of these products can become more environmentally friendly in their energy use by…'. Unfortunately writing it out did not help them address what was asked, nor did it earn them any credit.

18(a) The LED lamp and paraffin lamp did bring out many advantage points and was well answered. However, lots of assumptions were made about the relative energy efficiency of the two lamps, the 'convenience of battery power' often given as the main advantage of the LED lamp. Light 'Quality' was rarely, if ever, mentioned.
18(b) SolarAid as a concept was not well understood with many general answers about selling electricity and not referring to the use of the light systems and their advantages.
18(c) web answers were well completed.
18(d)(i) Solar panels on a roof were well-recognised but advantages showed some confusion about how they work with evidence of some common misconceptions e.g. water heating and backup for power outages or even 'power at night' in several cases. Most candidates provided two good answers.
18(d)(ii) Renewable energy was well understood and answered.

A513 Making quality products

General comments

Centres are now working more smartly for the whole project. When work is completed as a PowerPoint candidates do work in a more focussed way, without too many irrelevant pages. Paper folders still tend to be too large, especially at the start of designing.

The completed product continues to be made to a good standard. Many Centres are relying on library circuits, either school based or from software, leading to whole centres of very similar solutions.

Designing

Using a mind map is still the main way to start investigating the theme. Candidates do then look at the situation of the problem area and it is here where more work than is necessary is often done. It is sufficient to illustrate the problem area with images and comments without carrying out surveys.

The design brief has tended to be a possible solution rather than just stating the need and problem. The statements do need to be open to allow for a variation in proposed ideas. There is confusion in the next stage with many centres carrying out a product analysis. Information and data needed is about the problem, user and/or client group.
When writing the specification candidates have tended to use a series of headings which can lead to a general list which lacks focus. Centres should encourage candidates to think more clearly about the function and meeting the needs of the user.

Many centres are using a system approach at the start of ideas, but centres must ensure candidates' work beyond blocks to show full circuits. Centres are adopting two approaches or a range of differing ideas with one selected or a single idea which is developed and improved in subsequent circuits.

Selection is still a poorly completed section, where most reasons seem to be based on the ease of making the circuit or system, rather than consideration of the user. Modelling, either on breadboard or virtually via software tends to be just a repeat of the selected idea. Candidates should be using the opportunity to develop and improve the initial idea. When PicAxe chips are used, modelling is where the control program is developed. Candidates must explain the blocks of control within the program rather than just comment on the final operation.

The casing of structure needs to be developed in the same way as the control system; too often poor pencil sketches with simple comments are presented. Selection has little relation to the needs of the user. There has been some good use of CAD, with Google sketch-up being favoured. It is good to see the direct connection to manufacture where centres have laser cutters for either mould making or directly cut container materials. Where centres use bought cases it is important candidates show in detail how the box is being used. Fixing of the PCB, battery and cable routing must feature in the design work.

The final design is shown as the PCB mask or the mechanism layout together with dimensioned details of the container or structure. Most candidates are now able to produce the correct information to start manufacture.

Successful candidates:

- Quickly identify from the theme the work area they are interested in, providing information to illustrate the problem.
- Set the situation using a design brief leading to an action plan for the resources and information needed. Clearly focussed information is gathered about the user/client group. This may include ergonomic data, causation of the problem and any important component data. A summary brings out bullet points which must be considered.
- State clearly the function and performance of the product in the design brief. Points are measureable 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. Selection reasons are 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 centres are now producing variations of the planning sheet considering materials, equipment, quality control and time. Candidates do need to consider the whole product and breakdown the system, the structure or container and the assembly. Quite often the full detail is missing.

Candidates have been able to demonstrate good quality making both in the control system and case or structure. In a few centres the PCB was a pre-manufactured item where the candidate did not contribute much of the design, therefore limiting the mark awarded.

Dry produced PCB with cnc milling does cause later soldering problems because of the narrow insulation gaps. To achieve the top marks in the making section candidates do need to consider how parts are assembled; on a PCB, resistors should be flat on the board and parallel; off-board wires should have a cable clamp to ensure they are not pulled out; wire links should be flat on the board, not looped over components; off-board components should have good insulation from their own legs and other metal parts. Electronic products must have cables and battery fix to stop the bird's nest effect.

Solving Technical Problems

It is expected 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. 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.

Record Key Stages

This section has been a real success, and most candidates are proud to display images of how they made the product. Centres are really organised now to record and store the pictures. 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 which took place before making and recording of making during/afterwards is distinct in the evidence provided.

Successful candidates:

- Include a production planning chart which really 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. Solving technical problems is demonstrated with a written log.
- Record the key stages of manufacture with a set of detailed pictures with comments of the stages, even showing the test set up to with the product working. If using PowerPoint short video clips record stages and/or testing.

Critical Evaluation

Most candidates did use the specification when looking at the final product. This comparison only works when the specification is written as measureable points for the performance of the product. Writing general points of sustainability and global descriptions makes evaluation more difficult and less effective.

Using members of the user group can give some good feedback when the group makes constructive comments rather than saying it is all good.
Effective bench 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 do arise. It is important to have the candidates own work rather than some class points.

Successful candidates:

- Write critical points when comparing the specification with some discussion. Testing shows clearly how the product works for the user group and brings out points where the prototype needs modifications and changes. Sketches and notes show how the second prototype will be different and improved.
- Organise their folders and use a range of technical language correctly.

A514/01 Technical aspects of designing and making - Electronics Paper

General comments

The result this year continued the trend of 2012 with fewer 'no response' answers and very few candidates who had failed to complete the paper. Once again 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 become inaccessible. There were fewer instances of 'bullet point' lists or repeated points within these questions, which is a positive sign.

It was apparent that basic techniques such as identification of resistor value using a colour code are no longer being covered to the extent that they once were. These techniques are still needed for controlled assessment so they should not be neglected. While it is convenient to use simulation software for a number of the circuits that must be covered, it is also important that techniques such as bread boarding are included in the learning experience. The use of a multimeter for testing voltage, resistance and current on real circuits should be an essential part of any electronics course.

Knowledge of commercial practice 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 manufacturing techniques.

Section A

1 (a) (i) The majority of candidates scored at least one mark on this question. There were, however, a number of responses where the colours given bore no resemblance to the values of the resistor.

(ii) In general, those candidates who had scored full marks for the previous part gained two marks for the high and low values in the range produced by tolerance.

(b) (i) Those candidates who gained marks for this part generally understood that a potentiometer will allow the output voltage to be adjusted whereas fixed resistors will not. Only the higher achieving candidates gained the second mark for recognising that a 1K resistor in series will make little difference to the output, but will prevent the resistance across the rails from being reduced to zero.

(ii) The calculation was carried out accurately by the majority of candidates. The only problem seemed to be in the correct rounding to one decimal place, 4.89 being frequently rounded to 4.8 rather than 4.9.

(c) This question was not well answered and generally showed a lack of understanding of multimeters. Those who were successful generally gained a mark for placing the common probe on a 0V point on the breadboard; very few had correctly placed the positive probe to the potential divider output. The question asked for the correct position for the multimeter switch but a significant number of responses showed no attempt to identify the correct position. Those who did show the altered switch often placed it in the AC volts or ohms position.

2 (a) (i) With the exception of those who had stated ‘vacuum forming’ the majority gained a mark for ‘injection moulding’.

(ii) It is important that material properties are given as specific terms. ‘Durable’, ‘scratch resistant’ and ‘electrical insulator’ were all acceptable; ‘strong’ was not.

(iii) The casing was shown clipped together, which will normally mean that a casing is not designed to be opened for repair. A number of responses gave ‘ease of access’ as the reason for using clips; experience of disassembling products would have shown that to not be the case.

(b) (i) This part was well answered with the majority of all candidates gaining both marks.

(ii) Most candidates realised that the plastic block will prevent the LED legs from bending for one mark. Many also gained the second mark for recognising that the block prevented legs from touching.

(iii) Surface mount technology was not well understood. Those who gained a mark had generally given the reduced circuit/PCB size as the reason for its use. Higher achieving candidates also noted that the components are ideal for pick and place machines and require no drilling.

(c) The use of test points was generally described as ‘testing if the circuit will work’. This gained one mark and few responses referred to automatic testing of complete boards or diagnostic testing once a circuit is installed in a product.

3 (a) (i) This question was generally well answered with many candidates identifying that the pillar drill will always be vertical and is more rigid.

(ii) There were a high proportion of correct answers for this question.

(b) The majority of candidates gained at least one mark for this part. There was clear understanding that relay and IC socket legs do not have much room for manoeuvre so holes need to be accurate, whereas transistor and resistor legs can easily be bent into position.

(c) Knowledge of precision measurement was not widely seen. Many candidates gained a mark for recognising that the caliper is easier to read but then went on to state that the caliper is more accurate, which is not actually the case. Those who had used a digital caliper were aware that it could be easily set to zero and can also take inside readings.

(d)* The points most frequently mentioned related to quality of materials, design and machinery used. A few candidates considered that quality is adversely affected by use of mass production techniques. It was common for candidates to talk about a limited number of points and then repeat these points later in the response.

4 (a) This question achieved good differentiation with almost all candidates attempting a response. Those who understood the nature of the component parts to the system generally gained all three marks. Those who did not understand that a comparator requires two inputs had placed it immediately before the outputs.

(b) (i) The circuit to be completed was a comparator requiring connections to be added. Most candidates had correctly connected R1 to R2 to form a potential divider; understanding of the inverting / non inverting inputs was not as well known.

(ii) Any value of resistor that were the same would divide the voltage equally, in practical terms though, the values should be 1K or greater.

(c)* A few candidates tried to answer this question by referring to CAD in general terms rather than specific software for circuit simulation. Knowledge of specific software was good with the majority of responses giving both advantages and disadvantages.

5 (a) (i) This question differentiated well and identified those who were familiar with logic gates. The first two columns in the truth table were inversions of the inputs, a number of responses showed them as being the same as the input. A higher proportion of correct results was seen for the third column, the final output, which was a NOR gate truth table.

(ii) Those candidates who knew that a monostable output is a square wave generally gained both marks available. A number of responses showed the wave as a saw tooth rising slowly to 6V and returning slowly to 0V. A number of responses did not gain one of the marks because they did not show the switching on part of the square wave; they started at 6V and stayed there for 15 seconds before falling to 0V.

(b) (i) The most commonly gained mark was for the connections to the gate inputs for the monostable and sensor output. The NOR gate outputs should then have been taken to the inputs on the other side of the IC; this connection was frequently missed.

(ii) In addition to the candidates who did not respond to this part, there were a number who had connected both inputs and output to a power rail.

(c) The majority of candidates gained a mark on this question, generally for the recognition that the timing facility on a PIC is far more accurate and consistent than a monostable circuit. The ability to re-program the PIC was also given as a benefit.

(d) A number of responses did not gain marks because they had referred to mechanical rather than electrical safety. Better responses described the use of a fuse or of a double insulated casing. Use of an earth circuit was also mentioned in a few responses.

A514/03 Technical aspects of designing and making – Mechanisms Paper

General comments

Most candidates had clearly prepared well for this summer's examination with a number scoring full marks on technical questions. Candidates attempted most of the questions although a surprising number addressed what they wanted to write about in both the 6 mark written response questions, rather than answering the questions set. A smaller number than expected scored high marks on these questions, with some answers comprehensively explaining the benefit of brakes being added to bicycles rather than the significant improvements in braking systems now largely as standard in modern bicycles.

All candidates seemed to have sufficient time to complete the paper and were able to attempt most parts of most questions.

1 **(a)** The Effort, Fulcrum and Load were generally well identified with the position of the load causing the most difficulty.

(b) **(i)** A suitable material for the lever arm was appropriately answered with steel the most common correct answer. Weaker responses simply repeated 'stainless steel' from the question below.

(ii) The appropriate properties of stainless steel were generally given with most candidates giving at least one correct answer.

(c) The calculation proved more difficult with only a few candidates getting the correct answer and a large number treating the lever as a class 1 not a class 2.

(d) Lengthening the handle or adding a suitable grip enhancement was the most popular suggestions for improving the system with most candidates gaining at least one mark. Other suggestions were appropriate to the level of answer given, although a number added unnecessary bottom support (it was described as a wall mounted device), extra moulds and exotic delivery chutes.

2 **(a)** **(i)** Chain and sprocket was well known (duplex less so)and candidates regularly scored full marks in this section.

(ii) The advantages of the mechanism were well answered with most candidates able to use appropriate technical terms to gain at least one mark.

(iii) The disadvantages of the mechanism were also generally well answered with most candidates able to use appropriate technical terms to gain at least one mark.

(iv) The purpose of nut A and B was appropriately answered to the level of ability of the candidate but some did reverse the answer.

(v) Nyloc or self-locking was a popular answer.

2 **(b)** **(i)** Belt and pulley was well known but only a few candidates mentioned the V shape so most only scored one mark.

(ii) The tensioning device was answered appropriately according to the ability of the candidates.

3 **(a)** This was well answered with the correct words of rotary and reciprocating given by the majority candidates. Spelling was variable but credit was given when the intention was clear.

(b) The hazards of dust during cutting to the motor, mechanism and operator were well answered with the majority scoring full marks.

(c) A ratchet and pawl was generally well known, although the spelling of pawl varied.

(d) The use of gears and levers on bikes was generally answered at an appropriate level to the ability of the candidates. Most made reference to changing a gear to make riding uphill easier or to speed up downhill or on the flat. The operation of gears was expanded on by the higher ability candidates. Levers, however, were not so well answered, with only simple references to brakes; many candidates implying that any brakes on bikes was a recent innovation rather than the improvements to braking systems possible by clever use of levers.

4 **(a)** The pull-along toy should have provided ample opportunity for candidates to display their knowledge and ingenuity but the mechanism for moving the jaw and tail were not generally well answered, with only a few candidates scoring five or six marks. A basic CAM mechanism was the usual suggestion but the solution often lacked detail of how it would work, as well as a large number of candidates trying to move the top jaw and not the bottom. The tail proved even more difficult with only a small number able offer a suitable mechanism but a reasonable number managed some form of bevel gear to transfer motion through 90 degrees as a precursor to greater things.

(b) The question on Anthropometrics and Ergonomics in the design of a toy with a mechanism was commonly answered with reference to trapping fingers in exposed gears and swallowing small parts. Only a few mentioned sizes or average sizes or the comfort of the user and very few gave a definition of what the terms meant.

5 **(a)** **(i)** Most candidates were able to give some reason for using a splined shaft with the most common answer relating to positive location, however very few scored more than one mark with only a simple statement and no explanation.

(ii) The adjustment was answered at an appropriate level for the ability of the candidates with a large number scoring some credit.

(iii) A definition of torque was answered in line with candidate's ability.

(iv) The SI unit used for measuring torque was not well known.

5 **(b)** **(i)** Compound was generally well known.

(ii) Brass or Aluminium tended to be the most common answer but a number offered 'steel'.

(c) **(i)** The advantages of using a ball race was generally well answered with less friction or reference to built-in lubrication being the most popular answers.

(ii) The effect of repositioning the servo arm was generally well answered with a majority of candidates gaining some credit relating to less travel but the subsequent effect on the movement of the rudder was poorly understood and often not given.

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