GCE

Rewarding Learning

Chief Examiner's and Principal Moderator's Report

Technology and Design

Summer Series 2024

Foreword

This booklet outlines the performance of candidates in all aspects of this specification for the Summer 2024 series.

CCEA hopes that the Chief Examiner's and/or Principal Moderator's report(s) will be viewed as a helpful and constructive medium to further support teachers and the learning process.

This booklet forms part of the suite of support materials for the specification. Further materials are available from the specification's microsite on our website at www.ccea.org.uk.

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GCE TECHNOLOGY AND DESIGN

Chief Examiner's Report

Subject Overview

As in previous years, candidates taking this examination had to first sit the compulsory Design and Materials paper, followed by selecting and completing two questions from one of the three available options. In the AS 2: Coursework, there were a total of 686 candidates who entered the Product Development unit. In total, 721 candidates sat the compulsory one-hour Design and Materials option in Paper 1 (STE11).

For Paper 2, 247 candidates responded to the Electronic and Microelectronic Control Systems, 87 opted for the Mechanical and Pneumatic Control Systems, and the remaining 387 candidates chose to respond to the Product Design.

In the A2: Coursework, there were a total of 579 candidates who entered this unit. Of these, 136 candidates responded to the Electronic and Microelectronic Control Systems, 73 opted for the Mechanical and Pneumatic Control Systems, and 370 candidates chose to respond to the Product Design option.

Assessment Unit AS 1 Core Unit

All questions in this unit proved accessible, and there was no evidence across the paper to suggest that it was too long for the one-hour time allocated. A full range of marks was awarded, and candidates seemed to utilise the space well for all questions.

Q1 This question generated a mixed response. Many candidates were able to provide a brief explanation of elasticity and plasticity. Some did not refer to how the material would return to its original shape when outlining elasticity or how it would be permanently changed with plasticity. Part (b) on the whole was well answered, with many candidates able to explain the difference between electrical conductivity and thermal conductivity.

Q2 In this question, Part (a) and Part (b) on the whole generated a good overall response. In both parts, candidates should be encouraged to provide more than just a one-word response. In a small number of cases, candidates provided vague or generic answers which did not apply to the use of pipes or guttering, or lens covers for car lights.

Q3 This question was divided into three parts and overall generated a good response. In Part (a), the majority of candidates were able to provide a suitable property of oak which would make it suitable for indoor seating. In Part (b), many candidates were able to provide at least one advantage of plywood for indoor seating, but a number of candidates simply stated generic statements like 'cheap' and 'available'. Part (c) was well answered, but a number of candidates did not outline the fact that the purpose of a stain is to change the colour whilst leaving the grain visible.

Q4 The pressure die casting process generated a mixed response. In Part (a), many candidates were able to provide a suitable reason why pressure die casting is used for alloy rims for cars. In Part (b), a number of candidates confused pressure die casting with injection moulding, some did not provide a suitable sketch of the process, and some did not annotate the sketch.

Q5 This question focused on thermochromic, photochromic, and phosphorescent pigments and was divided into two parts. Part (a) on the whole was well answered, with the majority of candidates able to distinguish between thermochromic and photochromic materials, but not all candidates stated that the change was a change in colour. Part (b) was not so well answered, with a number of candidates unable to provide the main characteristic associated with phosphorescent pigments. In addition, some of the applications for the use of phosphorescent pigments were too vague.

Q6 This question generated a mixed response. Regarding solid modelling, a considerable number of candidates did not associate it with CAD-based work but focused on an explanation of the use of resistant material modelling. In the second part, which focused on solid modelling, candidates were not penalised for their incorrect explanation in the first part. As a result, the candidates' descriptions of how solid modelling could be used in the design and manufacture of a chosen product were appropriate to their explanations and generated a good response. Regarding rapid prototyping, many candidates simply viewed it as 3D printing and did not explain that it involved a broader range of manufacturing techniques. The candidates' explanations of how rapid prototyping could be used in the design and manufacture of a chosen product generated a good response. On a final note regarding this question, candidates need to be reminded that the quality of written communication is being assessed in this eight-mark question. As a result, it is important that candidates consider the use of appropriate technological vocabulary, ensure the content is organised, and that their spelling, grammar, and punctuation are accurate.

Q7 This question focused on two different design tasks for the storage box. In Part (a), candidates were required to provide a design that could be attached to the front and side panels of the storage box, provide protection to the vertical edge, and allow the user to adjust the height of the corner to ensure it sits level on the floor. This generated a wide range of solutions. The vast majority provided a corner protector but did not always explain how it would be attached to the side and front panels of the box. Many provided a threaded foot adjuster but did not show how the adjuster would stay in place or how it was attached to the base of the box.

In Part (b), candidates were required to redesign the top of the front and side panels of the storage box to reduce the chance of the user getting their fingers trapped between the panels and the lid when closing. A number of candidates did not redesign the front and side panels but added soft hinges, brackets, and stoppers.

In summary, for Question 7 (a) and (b), candidates need to produce more clearly annotated designs without repetitive sketches that do not show any additional information. In addition, the designs need to communicate a suitable solution with factual information related to the key aspects of the question in order for the marks to improve.

Assessment Unit AS 1 Paper 2 Option A, B and C

Option A Electronic and Microelectronic Control Systems

The examination paper was well-structured and covered a broad range of knowledge and skills from the specification. There was an appropriate balance of assessment objectives, and candidates achieved the full range of marks available. There was consistent evidence that candidates of all abilities were able to access marks in all of the questions.

Q1 **(i)** In the first part of this question, many candidates did not correctly identify the distinguishing feature of a micro switch, with many referring to its size.

(ii) Most candidates made reference to gate, anode, and cathode in their answers; however, some candidates made reference to the base, collector, and emitter.

(iii) Most candidates were able to achieve full marks in this question. Some candidates placed switches in line with the gate, and some added a potential divider for the PTM. Some candidates connected the reset PTM directly between the positive rail and the 0V rail, which would cause shorting of the circuit power supply.

(iv) Most candidates made reference to the back emf caused by the relay; however, a small number were able to state how the diode specifically provided circuit protection.

(b) **(i)** Most candidates were able to correctly calculate the power dissipated using the P=IV formula.

(ii) A significant number of candidates were able to calculate the correct value for the protective resistor; however, many doubled the voltage instead of the current. Marks were awarded for partially correct responses.

(c) **(i)** A smaller number of candidates were awarded full marks for this question. The most common errors were excluding the protective resistor for the LEDs or not having a viable switching method.

(ii) Most candidates were able to access full marks for this question.

Q2 **(i)** In the first part of this question, most candidates were able to refer to the variable resistor changing resistance; however, only a minority referred to how it would alter the Vout of the circuit.

(ii) Most candidates were able to determine the resistance of the thermistor at 15°C, but many were unable to correctly calculate the required value for Rv.

(iii) Some candidates simply stated how the resistance changed with temperature, rather than making reference to how Vo would be changed by swapping the positions of Rth.

(b) **(i)** A good number of candidates correctly described how the comparator amplified small changes.

(ii) Several candidates were able to achieve full marks in this question; however, marks were lost for not including the current limiting resistor for the transistor or not including appropriate dual power supply connections for the operational amplifier.

(c) **(i)** A mix of responses for this question; however, candidates could achieve marks if they stated ‘continuous’ and justified their answer by making reference to the system’s input.

(ii) This was a well-answered question, with many candidates achieving full marks.

The examination paper was readable, and the language used was fully appropriate for this level. There was no evidence that candidates had insufficient time to complete all questions in the examination paper.

Option B Mechanical and Pneumatic Control Systems

The paper was well-structured and covered a broad range of knowledge and skills from across the specification. There was an appropriate balance of assessment objectives.

Candidates achieved a wide range of marks, with some candidates demonstrating a high level of knowledge and accessing close to full marks. There was good evidence that all candidates, regardless of their ability, were able to access some or most of the available marks in most of the questions.

Q3 **(a)** The opening part of this question was generally well answered.

(b) This part was generally well answered by most candidates.

(c) A diverse range of acceptable answers was allowed in order to give benefit and fairness to candidates.

(d) Few candidates provided the exact answer on the mark scheme; however, a range of alternative ways to create the sequence were given full credit, which allowed many candidates to access full marks.

(e) This part was generally well answered. A small number of candidates inverted the formula.

(f) This question was not well answered by the majority of candidates who used the incorrect method to calculate the output speed.

Q4 **(a)** This part of the question discriminated between candidates of different abilities. A number of candidates used the diameter instead of the radius. A very small number of candidates did not use the correct formula.

(ii) This part was well answered, with most candidates identifying the correct class of lever.

(iii) A wide range of responses was provided, with partial marks being awarded for partially correct answers.

(iv) A small number of candidates correctly calculated the mechanical advantage.

(b) This question discriminated between candidates of different abilities. A variety of acceptable methods for appropriately connecting the motor and output shaft were accepted. A number of candidates did not add a label/labels.

(c) A range of actuation methods achieved marks. Some candidates used a pipeline between the 3/2 valve and SAC.

(d) This question was generally well answered, with most candidates explaining an appropriate safety consideration.

The language used was clear, unambiguous, and appropriate. There was no evidence that candidates had insufficient time to complete the paper.

Option C Product Design

This paper provided candidates of all abilities the opportunity to perform well. The questions covered a wide area of the AS product design specification, and the marks for the questions were well distributed. All questions in this unit proved accessible, and there was no evidence that the paper was too long for the time allocated. A full range of marks was awarded, and candidates seemed to utilise the space well for both questions.

Q5 **(a)** The first part of Question 5 was well answered, with most candidates getting one of the two marks. Some candidates needed to provide more information in their answer to reflect the second mark.

(b) **(i)** Part (b) focused on British Standards. Overall, this was quite well answered.

(ii) Concentrated on employee and customer safety. Most candidates were able to identify customer safety; however, some gave generic responses regarding the safety of the employee.

(c) With regards to the flow process chart in Part (c), some candidates did not refer to the characteristics and gave unsuitable answers, limiting their opportunity to gain the two marks for this question.

(d) With regards to QRM (Quick Response Manufacturing), in some cases, candidates confused this with Just in Time manufacturing, which meant that they did not achieve the allocated marks.

(e) Laminating. Some candidates did not provide specific enough answers to receive full marks in this question. Some candidates referred to steam bending instead of laminating.

(f) Focused on formative and summative evaluation. Some candidates were able to successfully identify summative evaluation; however, in some cases, they struggled to distinguish what formative evaluation entailed.

(g) The design question related to a guitar stand carrying 6 marks. The lack of quality sketches and annotation by many candidates restricted marks. Most candidates were able to highlight the height of 80 mm from the ground and the 60-degree angle in their design; however, they did not always identify how the materials were going to be minimised or how their design could fold for easy storage.

Q6 In Part (a) of this question, most candidate responses focused on a product instead of how the company could adopt the approach. In most cases, an appropriate reason was highlighted.

In Part (b), some candidates were confused as to what attribute analysis actually was, which limited their answers. Some generic responses were provided.

Part (c) focused on a work order. This was quite well answered, with most candidates giving a full explanation.

Part (d)(i) concentrated on the properties of CFRP. This was very well answered by candidates highlighting relevant properties.

In Part (d)(ii), the reasons offered by candidates why CFRP may be unsuitable were in most cases acceptable, but some candidates did not make reference to why it may not be suitable for the garden vacuum.

Part (e) focused on the water jet cutting process. This was well drawn and annotated, with most of the points highlighted in candidate responses. Some candidates did not make reference to the abrasive material being added to the high-pressure water.

Part (f) concentrated on the topic of registered design. In most cases, this was well answered; however, in some responses, candidates gave incorrect time frames.

(g) This was the final part of this question and to the section. Many candidates were able to highlight the distance of 50 mm from the ground; however, in some cases, they did not show how the new addition would be attached to the existing tube. Some candidates were unable to show how their design would be manoeuvrable.

There was no evidence to suggest that the candidates did not have sufficient time to complete the paper.

Principal Moderator's Report

Assessment Unit AS 2 Coursework: Product Development

The majority of centres continue to navigate the eCRS system with ease, presenting administration materials to a high standard that enables the moderation process to be conducted effectively.

In some centres, eCRS documentation contained only the mark awarded for each section or simply quoted the marking criteria. In examples where eCRS documentation contained little or no explanation for the marks awarded, it was difficult for the moderator at times to justify the marks given. Centres are reminded that the purpose of the moderation process is to ensure that the specification standards are applied consistently across all centres and is not for the moderator to re-mark the work of each candidate.

Centres are encouraged to make use of agreement trials, support events, and materials throughout the academic year.

Support materials and agreement trials continue to provide invaluable CPD opportunities, assisting teachers in becoming familiar with appropriate product selection and standards within this revised specification. Reviewing agreement trial material is of paramount importance and presents teachers with a valuable opportunity to review the work of candidates first-hand, in an effort to support continued communication of standards and approaches to the delivery of this unit.

Investigation and Analysis

This section continues to cause the least amount of disagreement between centre and moderator marks. It was generally completed to a high standard, with the moderating team largely able to agree on the marks awarded in the centre.

Selection of an appropriate product for re-design is paramount to the potential success of each candidate. The class teacher should act as a facilitator and ensure that the task the candidate undertakes is appropriate and achievable. It is important that class teachers make themselves fully aware of the specification requirements for the setting, taking, and marking of coursework (see Sections 7.2–7.4 inclusive).

When selecting four products for analysis, it is important that the candidate selects products that are similar. Similar products are considered to be those which fulfil the same purpose.

In examples achieving top mark band scores, candidates were found to clearly identify an appropriate product for redevelopment with a succinct discussion on areas for improvement. At AS level, four similar products are considered to be a broad range, with similar products being those that fulfil the same purpose. Most candidates referenced their sources, but this was not always consistent or sufficiently detailed – centres should be aware

of JCQ guidance on plagiarism and referencing (documentation updated and included as part of the annual Agreement Trial resource folder).

In examples that accessed the top mark band, candidates conducted a thorough analysis using a range of key headings. They discussed material properties in depth and how these related to the product, rather than simply listing a range of generic properties for that specific material. Top candidates also conducted a detailed analysis of sustainability considerations that explored the product in a manner that went beyond a simple discussion of recyclability, considering aspects such as dematerialisation, functionality, transportation, and packaging.

To complete this section, top candidates selected an appropriate product for redesign, giving detailed justification for this selection and clearly addressing the key areas for improvement. This not only assists moderation but also ensures that the candidate has clearly defined areas that they will develop throughout Section 2.

Redesign Solutions and Development

In centres where marking was considered outside of tolerance, it was this section and the Making section that moderators found to be the cause of the greatest disagreement during the moderation process. Quite often, the work presented did not meet the standard set out at the agreement trial to justify the top marks awarded in the centre.

In examples where candidates accessed the top mark band, they often had thoughtful and highly focused specifications. These specifications were clearly derived from thorough analysis of their selected product and areas for development, enabling candidates to produce an excellent array of quantifiable and measurable points. However, moderators frequently reported that specifications did not include a rich array of quantifiable and measurable points.

Moderators noted that, in the majority of candidate work accessing the top mark band, good hand graphics and CAD were used throughout this section. Top candidates employed a range of graphic communication skills to explore each area for development, as identified in Section 1 (Investigation and Analysis).

CAD is widely used to produce models for testing, provide 3D renderings for visual comparison or aesthetic details, and ultimately create detailed working drawings. Candidates accessing the top mark band for this section used CAD imaginatively to provide information on hidden details and to produce a range of models using CAM techniques. Some candidates still rely heavily on CAD in the early stages of redesign, when a range of sketches produced by hand would enable the candidate to explore potential solutions in a much more fluid fashion. This approach would also build upon exam technique for design-based questions in the terminal examination.

At times, candidates appeared to arrive at the final product abruptly, or it was clear that they had tailored their designs to suit particular CAM processes. Candidates should also be discouraged from simple “bolt-on” features.

Again, some centres are awarding top marks for work that is overly annotated. To access the top mark band, candidates should follow the cyclical nature of design when developing a range of redesign solutions.

Working drawings remain a concern during moderation. Often, when top marks are awarded for this section, a teacher will cite high-level working drawings as part of the justification for the mark awarded. However, these working drawings often do not follow set conventions (such as first or third angle projection), fail to indicate sizes clearly (to the nearest whole number), and/or lack detailed cutting lists. In the best examples, candidates produced working drawings that would enable third-party manufacture.

Making

Quality innovative thinking and the development of an appropriately redesigned product should inherently lead to high-quality product manufacture. This should clearly reflect the innovative design nature of the GCE specification.

In a number of centres, the moderator felt unable to support the marks awarded for work in this section due to a lack of creativity and innovation, which seemed curtailed in favour of simpler manufacturing techniques or limited time constraints.

Centres are reminded that to receive a mark in the top band for this section, a candidate does not necessarily need to increase the number of processes or materials. Instead, they should select these appropriately for the function and purpose of the final product. In some cases, moderators reported that centres awarded higher marks for larger products despite a lack of innovative design or complex manufacturing techniques being displayed.

In some instances, moderators reported a lack of finishing on parts completed using CAM processes. Centres are reminded that:

"High-quality CAM and/or hand skills are to be encouraged for candidates to access the top band marks. Products using, e.g. router, laser, 3D printer only, will require additional workshop skills to achieve high-quality outcomes and therefore access top band marks." (AS Amplification Document)

In the best examples, candidates displayed a range of skills in the manufacture and finish of a product that was clearly influenced by the cyclical nature of the redesign and development process – innovative design was realised in the final manufactured outcome.

Centres are reminded that candidates should complete manufacture within their own school or college, and attention is drawn to section '7.2 – Setting the tasks' of the specification:

'Teachers should give guidance in the planning and realisation of each internal assessment task to ensure that:

- tasks do not contravene Health and Safety at Work legislation; and
- the candidate's school or college can facilitate the design and realisation of the task.'

Care should be taken to ensure candidates do not complete work for which they cannot receive credit.

Testing and Evaluation

By and large, moderators reported that they could largely endorse centre marking in this section but noted that the quality of specification writing and a meaningful evaluative exercise on the final product are intrinsically linked. Moderators reported difficulty in agreeing with centre marks when specifications lacked quantifiable and measurable points, as this often led to superficial comments in this section.

More consideration in this area would invariably lead to the deeper thinking required at this level when evaluating final products. Future modifications in a number of cases were found to be merely 'bolt-on' parts to meet the requirements of the subject specification. In the best examples, candidates linked their findings during evaluative exercises with detailed drawings and CAD representations of changes they would make to support and justify their commentaries.

This section concludes candidates' work and is an opportunity for them to demonstrate knowledge and understanding of key technical aspects of their redesign product. Often, this section appears hurried, which results in a poor standard of work that is not indicative of the subject specification at GCE level.

Chief Examiner's Report

Assessment Unit 2 1 Option A, B and C

Option A Electronic and Microelectronic Control Systems

Q1 **(a)** **(i)** For this introductory question, most candidates correctly stated how the resistance of an LDR changes as light levels increase.

(ii) The responses to this question were mixed, with many candidates sketching a curved graph but in the incorrect direction.

(iii) Candidates answered this question well, with most correctly calculating the output voltage range for the voltage divider. Full marks were awarded to candidates who presented the range as a single value.

(b) **(i)** This question was answered well by most candidates, although a significant number of responses did not indicate the position of the LDR relative to the slotted disc and were only awarded 1 mark.

(ii) This question was answered well, with most candidates referring to the issues associated with ambient lighting. A significant number of responses did not refer to the slow response time of an LDR. The majority of candidates suggested an optical switch as an alternative.

(c) **(i)** This question was themed around a system to count pulses, and most candidates did not write a concise and accurate explanation of the function of an AND gate in the system. Most candidates were awarded 1 mark.

(ii) Up to 3 marks were available for candidates who correctly calculated the division factor for the frequency divider. Candidates were awarded partial marks for determining the number of pulses in the 10-second period.

(d) **(i)** This question was generally answered well, although while most candidates made reference to a falling edge in their explanation, a significant number of responses did not refer to the high-to-low transition.

(ii) This question was poorly answered by most candidates, who were unable to show how an appropriately connected AND gate could act as a reset for the frequency divider.

(e) In the Quality of Written Communication (QWC) question, marks were awarded for a well-structured description of two main characteristics of strain gauges. Candidates were also required to explain why a Wheatstone bridge is used in conjunction with a strain gauge and to discuss the issues associated with temperature variations. Most candidates provided sufficient, well-structured content to access the available marks. Some candidates used repetitive points in their responses and therefore could not access the full mark range. A small number of candidates did not write sufficient text to enable more than 3 marks to be awarded.

(f) Most candidates produced annotated circuit diagrams and associated flowcharts that correctly met the five specification points for the industrial flow rate system. The most common errors were in relation to the 12-volt sounder and the appropriate flowchart to measure the length of a pulse. There were some very good flowcharts which made good use of decisions, subroutines, and loops to produce the flash sequence for the red LED and buzzer. Candidates should be encouraged to annotate their flowcharts to show their thinking.

Q2 **(a)** **(i)** This question was answered well, with the majority of candidates correctly showing how multiple LEDs are connected in a common cathode display.

(ii) Responses to this question were generally good, with many candidates awarded full marks for a valid explanation of the advantages of using an LED display over an LCD display.

(iii) The vast majority of candidates presented an appropriately labelled sketch showing how the disc could be modified to operate a reed switch twice in one complete rotation. Candidates should be reminded that where a question asks for labelling, full marks cannot be awarded where there are no labels.

(b) **(i)** The calculation of the protective resistor value was generally answered well, with the most common error being the incorrect LED current. Partial marks were awarded for a correct method.

(ii) The calculation of total power dissipation for the calculated protective resistor was correctly answered by a minority of candidates. Most candidates were unable to incorporate the multiplication factor for the number of LEDs. Again, partial marks were awarded for the initial correct steps in the calculation.

(iii) For this question, candidates were asked to produce a flowchart to display the appropriate fan speed number. The majority of candidates produced a working flowchart, but very few were awarded the mark for using the minimum number of commands.

(c) **(i)** The specific purpose of a seven-segment decoder was the focus of this question, with most candidates being awarded 1 mark.

(ii) A high number of correctly completed truth tables were noted for this question.

(iii) Most candidates produced a coherent and accurate explanation of why minimisation was not applicable.

(iv) Candidates were required to write logic expressions for two outputs, with most responses attaining 2 marks.

(v) For Part (v), candidates were required to draw a logic circuit for both outputs. Where candidates had incorrectly stated the logic expression in Part (iv), they were still able to access full marks provided that the logic circuit matched their logic expressions. A pleasing number of correct responses were noted for this question.

(d) **(i)** The calculation of gain for the specified op-amp was correctly answered by the majority of candidates.

(ii) For this synoptic question, candidates were asked to produce an annotated hard-wired circuit based on a non-inverting op-amp. There were a wide range of responses to this question, with most candidates scoring between 4 and 9 marks. For full marks, candidates were expected to include an accurate calculation for appropriate Rf/Ri resistors and a hard-wired means of making a buzzer sound on and off. Many candidates produced practical and accurate circuit diagrams, making use of an astable timer; however, the most common errors noted were incorrect values for Rf/Ri and inaccurate circuit diagrams for an astable timer. There was some evidence that a number of candidates did not leave sufficient time to complete this final question.

Option B Mechanical and Pneumatic Control Systems

Q3 (a) (i) This introductory question examined candidates' knowledge of viscosity and SAE classification. A pleasing number of correct responses were noted.

(ii) The ratchet and pawl mechanism was the focus of this question. Candidates who used an annotated sketch to outline the main features were awarded up to 3 marks. There were a wide range of acceptable sketches; however, some candidates had sketched rack and pinion mechanisms and could not access any marks.

(iii) There was a significant number of correct responses to this question, which required candidates to explain three functions of oil in a mechanical system. Some candidates provided repetitive responses associated with friction reduction and did not attain full marks.

(b) (i) This calculation question based on a lever was generally poorly answered, with a significant number of candidates unable to apply moment equations to a class 2 lever.

(ii) This was another calculation question where candidates were required to calculate the equivalent single-cylinder outstroke force and corresponding cylinder diameter. Where candidates used an incorrect force, they were not penalised for an incorrect cylinder diameter provided it was correctly calculated as the error was carried forward.

(c) (i) The quality of written communication (QWC) was assessed in this question, which focused on three types of transmission clutch. The responses were generally good; however, some candidates produced similar or generic responses for each clutch type, and some did not write sufficient text to access the full range of marks.

(ii) A pleasing number of candidates provided excellent annotated sketches of a disc brake; however, a number of responses had unsatisfactory explanations of the method of activation.

(d) This question discriminated between candidates. A diverse range of solutions was suggested and accepted. A minority of candidates designed a response that focused solely on pneumatic components. Several candidates transferred the motion through 90 degrees but did not include linkages or consider the angles of transferred motion. A small number of candidates designed a method that only locked pin A or B. Candidates should be encouraged to annotate their sketches to support their designs and thereby access full marks.

Q4 (a) (i) A self-aligning bearing was the focus of this question, where candidates were asked to produce an annotated sketch outlining the main features. The responses to this question were generally good.

(ii) The response to this question was disappointing, as few candidates were able to correctly articulate one reason for using a self-aligning bearing.

(b) This air consumption calculation was generally well completed by most candidates. Marks were awarded for partially correct answers and a correct method.

(c) This question required candidates to complete a group changeover pneumatic circuit to satisfy a given specification. As in previous series, this question was well answered by the majority of candidates. As always, clear labelling of group changeover signals and accurate piping lines help to confirm the candidates' designs. The most common error was the incorrect piping of the 5-port valves for appropriate group changeover. A pleasing number of candidates were awarded between 8 and 10 marks.

(d) **(i)** Most candidates correctly stated the direction of rotation as clockwise.

(ii) A good number of correct responses were noted for this question, which required the calculation of a velocity ratio.

(iii) In this question, candidates were required to calculate the output speed of the given system. Where candidates used an incorrect velocity ratio from the previous question, they were not penalised, provided the output speed was correctly calculated as the error was carried forward.

(iv) The responses to this question, which was based on a crane hoist, were generally inaccurate. A number of methods used incorrect formulae, and a significant number presented numerical errors, particularly in relation to the efficiency consideration.

(e) Candidates were required to complete a performance/displacement diagram for this question. Most candidates were awarded marks for the dwell and uniform motion sections; however, there were a significant number of incorrect methods for showing uniform acceleration and deceleration. Similarly, a number of candidates failed to draw an appropriate fall with uniform motion.

(f) For this question, a solution to operate a loading ramp by means of a hand wheel was required. The majority of responses successfully included a bevel gear system to change the direction of motion; however, an appropriate mechanical advantage was not always evident. A variety of mechanisms to move the ramp were produced, and where these were appropriate, they were awarded marks. Marks could only be awarded to mechanisms that were clearly annotated to explain the candidate's design.

Option C Product Design

Q5 **(a)** The opening part of this question involved candidates explaining what was meant by an incremental product. In most cases, this question was answered well; however, some answers lacked the detail needed to obtain the second mark.

(b) **(i)** Candidates were asked to explain what was meant by an environmental audit. Overall, most candidates completed this question well.

(ii) This part focused on the benefits of an environmental audit. Similarly to the previous question, this was also answered well, with many candidates highlighting the improved public relations (PR) of a company.

(c) This question required candidates to explain one main issue regarding the sustainability of plastics manufacturing. The responses were mixed, with some candidates effectively highlighting the negative environmental impact of the plastic extraction process, while others provided very generic statements that did not address the question.

(d) **(i)** Candidates were asked to explain the process of market penetration. Most achieved one mark but did not provide enough information to gain the second mark.

(ii) Similarly to the previous part, candidates were able to identify that diversification would generate increased sales but did not always address the range of product options.

(e) This question required candidates to explain two main benefits of flexible manufacturing systems (FMS). Some candidates gave generic responses that did not allow them to achieve the full range of marks available.

(f) This question carried 9 marks and required candidates to describe the characteristics of different consumer types, specifically fashion innovators, opinion leaders, and laggards. This question was well answered, with candidates able to identify the main characteristics of each group. However, in some cases, candidates confused the characteristics of fashion innovators and opinion leaders.

(g) **(i)** This question was well answered and required candidates to briefly outline two advantages and one disadvantage of personal selling.

(ii) Similarly, this question was well answered and focused on candidates outlining two advantages and one disadvantage of exhibitions. Most candidates performed well on this question.

(h) This was the final part of the question and provided candidates with the opportunity to undertake a 10-mark design question based on attaching a bracket to a measuring wheel to hold a mobile phone in place to record the data on the display of the wheel. A wide range of solutions was evident. The sketching and annotation varied throughout, with some candidates providing more detailed responses and, in some cases, producing imaginative solutions. In a number of responses, aspects of the question were not addressed. Some candidates did not reference how the bracket angle could be adjusted to facilitate recording, while others did not provide an appropriate method for attaching the bracket to the shaft. Weaker responses showed limited problem-solving skills.

Q6 **(a)** The first part of this question required candidates to focus on two main benefits of innovation. In most cases, this question was well answered, with candidates being able to outline two appropriate benefits.

(b) **(i)** Candidates were required to explain the key element of refuse. In most cases, this was well answered, but some candidates needed to expand slightly in their response to achieve full marks.

(ii) Candidates were required to explain the key element of reuse. This was well answered in most cases, but some candidates needed to expand slightly in their response to achieve full marks.

(iii) Candidates were required to explain the key element of reduce. Like the previous two parts of this question, this was well answered; however, some candidates needed to expand slightly in their response to achieve full marks.

(c) This question focused on relaunching a product. Candidates did not always provide detailed responses, which hindered their ability to achieve the marks awarded for this question.

(d) **(i)** This part required candidates to explain how environmental impact could be reduced through manufacturing. This question generated disappointing responses. Many candidates did not relate their answers to a manufacturing process but rather gave generic responses about environmental impact.

(ii) This part focused on explaining how the environmental impact of a product could be reduced at the end of the product's life cycle. Some candidates provided generic responses that did not fully address the question.

(e) **(i)** This question looked at how measuring devices assist with quality control and produced a range of responses. Some candidates provided a relevant form of measuring and referenced acceptable tolerances, while others gave generic responses that did not address the question. In some cases, this question was left unanswered.

(ii) Similarly, this question looked at how fixtures assist with quality control and produced a range of responses. Some candidates understood the purpose of a fixture and answered this well, while others gave generic responses that did not address the question. In some cases, this question was left unanswered.

(iii) The final part of this question examined how templates assist with quality control and also produced a range of responses. Many responses referenced a guitar template assisting with accuracy; however, in some cases, this question was left unanswered.

(f) **(i)** This part involved candidates explaining the concept of elasticity of demand. Most answers were quite generic and did not allow candidates to access both marks.

(ii) This question asked candidates to explain what was meant by contribution pricing. Most responses were basic and, in some cases, referred to cost-plus pricing.

(g) **(i)** Candidates were asked to describe a product that incorporates social factors in its design. In a number of cases, candidates struggled to highlight an appropriate product, which in turn limited their ability to describe how it incorporated social factors in its design. In some cases, this question was left unanswered.

(ii) This part focused on candidates describing a product that incorporates cultural factors in its design. The selection of an inappropriate product hindered some candidates' ability to address how it incorporated cultural factors in its design.

(h) **(i)** This was the first design element of the last question in the paper, consisting of two two-mark sections. Candidates were asked to provide an innovative annotated sketch that communicated to the customer that the drone should not be flown at a height exceeding 100 metres, and that flying time on fully charged batteries should not exceed 30 minutes. In most cases, candidates were able to achieve half marks in each part of this question. Some candidates produced a written explanation with no sketching, while others graphically portrayed their designs with some relevant annotation.

(ii) This is the final part of this question and the section, worth 6 marks. It required candidates to design packaging that minimises the materials and space required for the drone and its accessories. In some cases, candidates did not provide suitable protection for the contents or give relevant dimensions in their responses, limiting the marks awarded.

Principal Moderator's Report

Assessment Unit A2 2 Coursework: Product, System Design and Manufacture

Overview

The majority of centres continue to navigate the eCRS system with ease, presenting administration materials to a high standard that has facilitated the moderation process. However, in some centres, eCRS documentation simply contained the score awarded for each section or quoted the marking criteria without sufficient explanation. When eCRS documentation lacked detail about the rationale behind the marks awarded, it sometimes proved challenging for the moderator to justify the scores given. Centres are reminded that the moderation process aims to ensure that specification standards are applied consistently across all centres, and it is not intended for the moderator to re-mark each candidate's work.

Centres are encouraged to utilise agreement trials, support events, and materials throughout the academic year. These resources and trials continue to offer invaluable CPD opportunities, helping teachers become familiar with appropriate product selection and standards within the revised specification. An annual review of agreement trial material is of paramount importance, providing teachers with a valuable opportunity to examine candidates' work first-hand and supporting ongoing communication of standards and approaches to delivering this unit.

Identifying a Problem, Client or User Needs and Design Specification

In general, this section appears to be well embedded, with a significant number of candidates achieving the top mark band for their work. The importance of selecting an appropriate problem with sufficient scope for development and providing extensive opportunities for innovation must not be undervalued at this stage of the project work. This cannot be emphasised enough for candidates following the Product Design option. Candidates should be encouraged to explore a problem in detail to ensure that there is ample scope for design, development, and ultimately manufacture.

Candidates should be cautious about selecting a sibling or peer as their client, as this can often lead to limited design opportunities due to a lack of detailed discussion about client needs. In several cases, candidates selected a client or user with a problem very familiar to them, which resulted in a narrowing of creativity in the design and development phases. This often led to final products resembling those already on the market, featuring only basic 'bolt-on' accessories.

Analysis of existing products continues to be structured and conducted appropriately by the majority of candidates. The use of key terminology, such as materials, sustainability, and manufacturing techniques, is encouraged. However, candidates should ensure their analysis is specifically related to the product being examined, rather than a generic discussion about material properties. Candidates should also build upon sustainability considerations beyond material recyclability – using AS learning to consider aspects such as dematerialisation,

packaging, and transportation. Problem identification analysis and design specification remain areas for improvement.

Design specifications continue to be an area needing enhancement. Measurable, quantifiable, and relevant points drawn from the analysis will enable candidates to explore a range of innovative design solutions. Detailed specification points will also inform the design and development process and facilitate thorough testing of the completed product.

Initial Ideas, Selection of Ideas for Development

Quality design thinking and innovation must be evident throughout this section of work. Unfortunately, in some cases, moderators reported that work receiving a mark in the top band did not illustrate innovative design or a high level of system or sub-systems. Some portfolios still carry a heavy weighting of annotation, which should be discouraged.

In the majority of system-based portfolios, candidates produced a sufficient range of system/sub-system designs appropriate for A2 level. However, in some instances, candidates described the function of a component rather than providing a detailed analysis of how the component could potentially solve the client's problem. Most candidates provided a range of suitable casing designs, demonstrating excellent CAD skills and some consideration for component placement. Candidates should be discouraged from excessive annotation and reminded that this section should focus on demonstrating innovation through their casing design. In the best examples, candidates utilised a wide range of graphic communication skills, blending hand graphics and CAD renderings to create innovative designs clearly guided by client needs. An infusion of hand graphics, CAD renderings, and non-linear system/sub-system design should be encouraged at this stage of the design process. Casing designs should include a range of graphics and/or CAD renderings to illustrate features, component locations, ergonomic details, etc. Often, casing designs are limited to CAD renderings with different views and a large proportion of the page dedicated to annotation. Large swaths of text should be avoided.

Product design portfolios remain a concern. Moderators frequently reported a lack of innovation due to limited design opportunities. Centres are reminded that class teachers should provide guidance in planning and realising each internal assessment task (section 7.2 'Setting the Tasks'). In some portfolios, it was clear that candidates had a fixed design in mind, which greatly limited the innovative nature of this section. Candidates should be strongly discouraged from including images of industrial processes or large drawings of generic fixings (such as butt hinges). In the best examples, candidates explored a wide range of ideas before selecting an appropriate one for development. Justification for this selection was often included but could be explored in more detail by clearly linking back to client needs. A blend of hand sketches and CAD renderings should be encouraged throughout this section, although there was often an overreliance on annotation that detracted from the design process. Top candidates used annotation to support high-quality graphics when communicating potential solutions to the problem.

Candidates should be encouraged to evaluate their proposals as they progress through this section, before drawing conclusions and deciding on ideas suitable for development. The selection of a proposed solution for development should be explicit.

Development

Unfortunately, moderators, in a number of cases, are still finding it difficult to agree with the marks awarded in this section. The design pathway can often be abandoned at this stage due to preconceived ideas or the over-development of initial concepts. Frequently, the final design, housing design, or system demonstrates a lack of development, with the final solution appearing early in this section. The GCE Specification rewards candidates who follow a design and development pathway. A premeditated design proposal or outcome will inevitably limit innovation and, ultimately, the marks that can be awarded.

A range of modelling techniques should be evident throughout the development process, incorporating CAD packages and physical models to allow candidates to make informed decisions. Modelling should be undertaken to test features of the system or product, with suitable annotation provided. It is encouraging to see that large swathes of generic information about manufacturing techniques are becoming less frequent in candidate work. Centres are reminded that such information adds nothing to the development pathway and attracts no credit.

The use of CAD is actively encouraged across the majority of centres, with some complex designs evident in several cases. Unfortunately, some moderators still report that a number of candidates are using the same CAD drawing repetitively rather than producing various parts or features to communicate functionality.

Candidates following the Systems pathway should be discouraged from simply arriving at a final system, followed by the PCB layout, flowchart, and casing design. Candidates achieving top marks should demonstrate how they have developed the circuit design by adding or removing components, how this impacts the PCB design, and how they then consider the flowchart development. The casing should demonstrate consideration for ergonomic details and component placement. Often, these key elements of a Systems Design folder can appear contrived and overly annotated.

Similarly, candidates following the Product Design pathway should be discouraged from turning developments into a storyboard exercise, merely outlining the stages of manufacture for various parts. Candidates often abandon the design and development pathway in favour of more basic, boxy designs that bear a striking resemblance to products currently on the market.

Numerical analysis should be integrated throughout this section. Some candidates choose to conduct this analysis once the final proposal has been reached. To achieve the top mark band, candidates must be encouraged to incorporate numerical analysis as part of the development pathway, formulating conclusions and making decisions based on the evidence provided.

Planning for manufacture and working drawings continue to improve. The best examples show clear consideration for each component part. Plans should be written in the future tense. High-band work continues to demonstrate high-level planning, with problems during manufacture addressed appropriately. Invariably, plans will change due to manufacturing constraints or difficulties, but these changes should be logged and not diverge greatly from the final development. Centres are reminded that working drawings should contain realistic measurement data and provide sufficient information for third-party manufacture.

Making

In a significant number of centres where moderators could not agree with centre marks, it was the Making section that often caused the most disagreement. It is crucial that each candidate carries through the innovation demonstrated in previous sections to produce a product that is highly functional and of A2 standard. In some cases, centres awarded work in the top mark band when the system was not fully functional or when the product lacked innovation.

CAM continues to be a popular method of manufacture, enabling candidates to realise some innovative and complex design solutions. However, some candidates still seem to be directing the design process towards specific CAM processes, which can occasionally limit innovation. Centres should encourage alternatives to CAM processes that are already available in the school workshop. At A2 level, work deserving of top marks should be finished to a high standard and incorporate several processes that demonstrate the candidate's working knowledge of material properties.

PCBs should be securely housed in the final casing and readily accessible for the visiting moderator.

Centres are reminded that work deemed worthy of the top mark band should be highly functional and capable of demonstrating this during moderation. Power and air supplies should be readily available for visiting moderators. Increasingly, video excerpts have been used to demonstrate a working system, which assists during the moderation process. Such videography should not replace a fully functioning product during moderation but should be used to justify marks awarded or as part of a product testing exercise. It is important that any videography used clearly demonstrates the system's functions, as detailed in the development section. At times, videos have only shown an LED turning on and off or a seven-segment display illuminating. Videos should effectively demonstrate the functionality of the candidate's system and how various inputs trigger specific outputs.

Testing and Evaluation

This section is often rushed by candidates due to time constraints and, as a result, can lack the detail required at this level. Candidates with relevant, measurable, and quantifiable specifications often achieve the top mark band for evaluative exercises. The use of video evidence has become more widespread, which aids in justifying the marks awarded. Centres should encourage this practice as it highlights how well the final outcome solves the client's problem and helps candidates identify further modifications.

Centres are encouraged to build upon AS work by providing adequate time and portfolio space to discuss further modifications. This should not be overly verbose but should instead include a range of CAD, modelling, and annotation based on test results. In the best examples, system improvements resulting from product testing were considered alongside potential housing modifications – this practice should be actively encouraged.

Contact details

The following information provides contact details for key staff members:

- **Specification Support Officer: Nuala Tierney**
  (telephone: (028) 9590 6689, email: ntierney@ccea.org.uk)
- **Officer with Subject Responsibility: Judith Ryan**
  (telephone: (028) 9590 6550, email: jryan@ccea.org.uk)

COUNCIL FOR THE **CURRICULUM, EXAMINATIONS** AND **ASSESSMENT**
29 Clarendon Road, Clarendon Dock, Belfast BT1 3BG
Tel: +44 (0)28 9026 1200 Fax: +44 (0)28 9026 1234
Email: info@ccea.org.uk Web: www.ccea.org.uk

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