GCE

Rewarding Learning

Chief Examiner's and Principal Moderator's Report

Technology and Design

Summer Series 2023

Foreword

This booklet outlines the performance of candidates in all aspects of this specification for the Summer 2023 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 and Principal Moderator's Report

Subject Overview

After the disruption caused by the COVID 19 pandemic, it was good to visit schools again and observe the hard work of students and teachers after the first 'normal' series since 2019. As in previous years candidates taking this examination had to sit first 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. There were 715 candidates, in total, in Paper 1 (STE11) who sat this compulsory one-hour Design and Materials option. In Paper 2 there were 189 candidates who responded to the Electronic and Microelectronic Control Systems, 120 opted for the Mechanical and Pneumatic Control Systems, with the remaining 406 candidates choosing to respond to the Product Design. In the A2: Coursework: there were a total of 570 candidates who entered this unit. There were 132 candidates who responded to the Electronic and Microelectronic Control Systems, 60 opted for the Mechanical and Pneumatic Control Systems, with 380 candidates choosing to respond to the Product Design option.

Assessment Unit AS 1 Core Unit

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

Q1 This question generated a mixed response by candidates. Many were unable to explain the term factor of safety, instead they discussed safety features and issues associated with risk assessments. In contrast Part (b) was well answered with many candidates able to provide two reasons why common form and sizes of materials are used.

Q2 This question generated a good overall response. In Part (b) a number of candidates gave a characteristic but not a working characteristic associated with Ash.

Q3 The first part of this question was dealing with the property of aluminium alloy for a ladder, and this generated a good response. However, the second part dealing with the property of mild steel was not so well answered as many candidates stated a reason rather than providing a property. In the third part which focused on the plastic coating process many candidates displayed very limited knowledge of the process or confused it with a different process.

Q4 Part(a) of this question was answered well with most candidates able to provide a suitable property of nylon which made it suitable for clothing. In Part (b) many candidates were able to provide a suitable application for the use of ABS but many provided a reason or characteristic rather than a property for their stated application. Part (c) was well answered by many candidates, but some provided properties of graphene which would not be considered suitable for use in television screens.

Q5 The blow moulding process was generally well answered. Some candidates did not include the air or a split mould in their drawings and some did not annotate the sketch.

Q6 This question was not particularly well answered. A number of candidates did not fully explain what is meant by product review and testing or the importance of this stage in the design of their chosen product. Many candidates provided an in-depth coverage of the tests they carried out with their AS coursework but did not address the question. In addition candidates need to be reminded that in this question the quality of written communication is being assessed. 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 is accurate.

Q7 This question focused on two different design tasks for a sun lounger. In Part (a) candidates were required to secure a promotional graphics board to the back of the sun lounger. This generated a range of solutions. There were many examples of a housing for the board but no clear indication how it would be secured to the wooden frame of the sun lounger. In addition a number of candidates had some inappropriate means which would have pierced the fabric of the cushion or into the back of the user. In Part (b) candidates were asked to design a tray to fit the armrest of the sun lounger. Many candidates had some form of a sleeve with a tray on top which fitted over the arm rest but did not show how this would allow the user to secure it quickly and safely at the position shown on X-X. Many candidates correctly had a recess for a drinks glass but included a built-in container for snacks which was not required.

Overall candidates in this question needed to produce a clearly annotated design which communicates a solution to the key elements 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

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

Q1 **(a)** **(i)** The calculation of the time constant was well answered by most candidates. 1 mark was awarded for the correct method.

(ii) This was well answered as most candidates correctly answered in relation to the availability of large capacitance values for electrolytic types.

(iii) In this part the responses covered the full range with most candidates correctly showing an appropriate switch connected to 2 resistors. Some candidates used 2 capacitors and were awarded the marks provided that the value of the second capacitor was appropriate. A surprising number of candidates did not correctly show an appropriate discharge switch and resistor

(b) **(i)** The majority of candidates identified the function of the trigger pin in a 555 timer. However, many responses used vague explanations about how the timer is activated.

(ii) This question required the identification of the discharge pin. The most common error was to name it as the threshold pin.

(iii) This was generally well answered, where 2 marks were awarded for the correct connection of the pins 6 and 7 on a 555 timer. 1 mark was awarded for a partially correct connection.

(c) **(i)** Most candidates correctly determined the mark/space ratio. A ratio of 1.5:1 was also accepted.

(ii) In this question candidates were required to calculate the frequency of an astable timer. Many candidates made calculation errors in the pathway to the correct answer. Where candidates showed their working out, they were awarded partial marks for correct steps. Many candidates benefitted from gaining these partial marks demonstrating the importance of showing a method in the space provided.

(iii) This calculation was generally well answered with the most common error being the use of an incorrect value for the voltage drop across the protective resistor.

Q2 **(a)** **(i)** There was only one acceptable response for this question and most candidates correctly stated the logic as OR.

(ii) The majority of candidates seemed to struggle to articulate an acceptable response to this question. 1 mark was awarded for reference to 'pull down', however, only a full explanation that referred to the switch status could be awarded 2 marks.

(iii) This question was based on a standard protective resistor calculation which was generally well answered. Again, partial marks were awarded for a correct method and partially correct values.

(iv) Most candidates made a good attempt at calculating the power dissipation of the motor.

(b) **(i)** This question focused on the understanding of systems operation. The majority of candidates correctly identified the system shown as being on/off. However, the majority of candidates did not provide an adequate justification.

(ii) Candidates' responses to this logic question were mostly correct. A number of candidates omitted the small circle on the NAND gate symbol.

(iii) This question required candidates to explain the term latching in relation to electronic systems. Many candidates referred to the SR flip flop. While this was not required, candidates who did so were awarded full marks provided the explanation made appropriate reference to 2 distinct states.

(iv) For this question 5 marks were awarded for a correctly labelled circuit. Most candidates were able to correctly draw an SR flip flop. The most common errors were incorrect switch types and positions. A surprising number of candidates connected both outputs from the flip flop to the base resistor.

Option B Mechanical and Pneumatic Control Systems

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

Q3 **(a)** This was generally well answered although candidates did not always indicate the specific nature of the safety issue and some candidates did not suggest a procedure that matched the issue.

(b) **(i)** This was well answered by the majority of candidates. Candidates who produced a partially correct answer for the VR were awarded partial marks. Some candidates calculated the VR for the whole system. A number of candidates had ratios inverted and some made an attempt that could not be awarded marks.

(ii) For this question many candidates identified the need to divide 720 by the VR. A small number calculated the ratio from G-H as 1.5.

(iii) Was generally well answered. However, a number of candidates used an incorrect formula.

(c) A diverse range of sketches were produced. This was generally well answered. Candidates could not access both marks without annotation.

(d) **(i)** In this question a small number of candidates did not add main air to the system. A number of candidates did not insert the speed control on the exhaust side of the cylinder as considered good practice to avoid a jolting action. A pleasing number of candidates completed all parts of the question correctly.

(ii) The majority of candidates made a good attempt at this question. The majority completed the air bleed and connected it to the 5/2 correctly. A common error in this question was using an incorrect source for port 1 of valve C.

Q4 **(a)** A surprising number of candidates struggled to achieve the 2 marks in this question. Common errors included failure to identify reciprocating as 2 directions and confusing oscillating and rotary motion.

(b) **(i)** This was generally well answered. However, some candidates did not draw the eccentric cam with an obvious offset and some candidates put the follower at the top of the cam.

(ii) Most candidates identified and described the effect of a gradual rise and a sudden drop. A small number of candidates did not mention dwell in their answer. As no specific snail cam profile was shown, candidates were awarded marks for reference to no dwell or a short dwell.

(c) This was perhaps the most poorly answered question in the paper. Many candidates did not annotate their mechanisms, and many did not position an appropriate bell crank with the practical positioning of the pivot points.

(d) This was generally well answered, however, a number of candidates did not achieve full marks due to a lack of annotation or failure to include accurate depiction of the keyway in the shaft.

(e) The majority of candidates achieved full marks in this question with the most common error being the subtraction of the forces rather than the addition.

(f) This question required candidates to pipe an automatic circuit. Most candidates opted to use the cylinder activation air as the source for a time delayed signal. Some candidates added additional components, and this was given credit if the solution operated as required. Partial marks were awarded for partially correct time delays and flow restrictors. A number of candidates incorrectly showed a spring return for the reset of the on off valve.

Option C Product Design

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

Q5 **(a)** Fitness for purpose and reasons. This question was answered very well. However, some candidates need to be careful not to answer the second part (reasons) with an explanation of fitness for purpose.

(b) Reasons why one-off production is more costly than batch. Answers were limited as some candidates did not expand upon point raised.

(c) Die cutting process. A number of candidates included sketches of the blanking process. A number of candidates failed to provide a response to this part of the question.

(d) **(i)** In this part many candidates failed to outline two characteristics of a trademark. Some candidates did not provide specific enough answers to receive full marks.

(ii) Benefit of a trademark. This question was answered slightly better than the first part. Most candidates were able to obtain 1 mark.

(e) Design question, shopping bag carrier carrying 6 marks. There were a range of acceptable solutions given. It required candidates to produce sketches for a shopping bag carrier handle which is suitable for a left or right-handed person and can allow the user to quickly attach and secure up to three filled shopping bags. Reference should be made to a suitable material and manufacturing process if it was to be produced in large numbers. The lack of quality sketches and annotation by many candidates restricted their marks. Candidates who received marks in the high band tended to focus on what was being asked in the question and illustrated and highlighted the key points in their response. Candidates need to be reminded that a clearly annotated sketch is required to enable the examiners to understand the response and mark positively. Some candidates neglected ergonomic considerations or did not include viable manufacturing methods and materials.

Q6 **(a)** **(i)** Many candidates were able to outline what was meant by a design specification and consequently answered this question well.

(ii) Some candidates used generic terms which were not associated with a manufacturing specification.

(b) This question generated a mixed response. Some candidates were not able to apply the correct acronyms for scamper or able to highlight how they could help generate ideas.

(c) Reasons for using GRP. This was a well answered question.

(d) This question on concurrent engineering generated a mixed response. Some candidates were not able to apply two characteristics on concurrent engineering, instead giving generic responses.

(e) This focused on the difference between quality control and quality assurance procedures. This question again generated a mixed response. Some candidates answered this very well whilst others seemed to get quality assurance and quality control confused.

(f) **(i)** Was based on the influence of miniaturisation. Some candidates were able to identify a suitable product, however, in some cases they were unable to explain the influence miniaturisation has had on its design.

(ii) Was based on the influence of social change. Some candidates chose a product that did not reference social change.

(g) This is the final part to this question and to the section. Many candidates were able to design a window flag holder, but a number did not provide a suitable means to secure it to a car window. In several cases candidates did not address all aspects of the design question, which makes it challenging for the examiners to be positive when awarding marks. On a final note, candidates need to spend more time practicing these design-based questions to improve their responses, to give them confidence in their sketching and annotation and to utilise the space provided on the pro forma answer page.

Principal Moderator's Report

Assessment Unit AS 2 Coursework: Product Development

Overview

This academic year (2022-2023) candidates returned to pre-pandemic coursework specifications, including the making and testing sections. The majority of centres continue to navigate the eCRS system with ease, presenting administration materials to a high standard that enabled the moderation process to be conducted. In some centres eCRS documentation contained only the score 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 mark awarded. Centres are reminded that the purpose of the moderation process is to ensure that the specification standards are carried across all centres consistently and is not for the moderator to re-mark the work of each candidate. Whilst instances of candidates exceeding page limits as stipulated in the AS Technology and Design Specification, Unit 2 (Maximum of 10 A3 pages single sided), moderators reported that some candidates were straying into 11 or 12 A3 pages. In these cases candidates could not be rewarded for the work completed on these extra pages. 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. Review of agreement trial material annually is of paramount importance and presents teachers with the 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 marks that had been awarded in 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 re-development with succinct discussion on areas for improvement. At AS level, four similar products are considered to be a broad range, with similar products considered to be products that fulfil the same purpose. Most candidates referenced their sources, but this was not always consistent or sufficient in detail – 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 thorough analysis using a range of key headings. Discussing 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 detailed analysis of sustainability considerations that explored the product in a manner that went beyond simple discussion of recyclability by considering dematerialisation, functionality, transportation and packaging. To complete this section top candidates selected an appropriate product for re-design 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 he/she will develop throughout Section 2.

Re-Design Solutions and Development

In centres where marking was considered outside of tolerance, it was this section and the making section that moderators found the cause of greatest disagreement when conducting the moderation process. Quite often the work presented was not of the same standard, as set out at agreement trial, to justify the top marks awarded in 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/measurable points. Often, however, moderators reported that specifications did not include a rich array of quantifiable and measurable points. Moderators reported that in most of the candidate work accessing top mark band, good hand graphics and CAD were infused throughout this section. Top candidates employed a range of graphic communication skills to explore each area for development – as identified in Section 1. CAD is being used widely to produce models for testing, provide 3D renderings for visual comparison or aesthetic details and to provide detailed working drawings. Candidates who accessed 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 re-design when a range of sketches produced by hand would enable the candidate to explore potential solutions much more rapidly. This would also build upon exam technique for design-based questions in the examination. At times candidates appeared to arrive at the final product abruptly or it was clear that the candidate curtained 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 be following the cyclical nature of design when developing a range of re-design solutions. Working drawings are still of concern when conducting 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, often the working drawing does not follow set conventions (first or third angle projection), give clear indication of sizes (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 arrival of an appropriately re-designed product should, inherently lead to a high-quality product manufacture. This should clearly reflect the innovative design nature of the GCE specification. In a number of centres the moderator felt that they could not support the marks being awarded for work in this section due to a lack of creativity and innovation seemingly being curtailed in favour of simpler manufacturing techniques or limited time constraints. Centres are reminded that for candidates to receive a mark in the top band for this section the candidate does not necessarily need to increase the number of process or materials, rather he/she, should be selecting these appropriately for the function and purpose of the final product. In some cases, moderators reported that centres had awarded higher marks for larger products despite a lack of innovative design or complex manufacture techniques being displayed. In some instances, moderators reported a lack of finishing on parts that were 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 in the manufacture and finish of a product that was clearly influenced by the cyclical nature of the re-design 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 in large, moderators reported that they could largely endorse centre marking in this section but note 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/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 in order 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 commentaries. This section concludes candidates work and is an opportunity for them to demonstrate knowledge and understanding of key technical aspects to their re-design 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 A2 1 Option A, B and C

Option A Electronic and Microelectronic Control Systems

Q1 **(a)** **(i)** For this introductory question most candidates correctly sketched a straight line graph to show how the resistance between terminals on a potentiometer change as the adjuster is rotated.

(ii) The responses to this question were mixed with many candidates accurately explaining why an op amp can be considered as continuous. However, many candidates were unable to explain how the bar array display could be considered as on/off. Many candidates simply stated the term on/off in their answer.

(iii) Candidates answered this question well with most correctly calculating the required gain for an amplifier.

(iv) This question required candidates to draw and label a dual supply noninverting amplifier with suitable resistor values. A significant number of candidates did not accurately draw the amplifier where the most common error was to mix up the inverting and non inverting inputs. Most candidates were able to calculate appropriate values in the KΩ range for the resistors Rf and Ri. Marks were awarded for partially correct responses.

(b) In the quality of written communication (QWC) question, marks were awarded for a well-structured description of the general characteristics of op-amps. Candidates were also asked to discuss the main features of the differential mode of operation. Most candidates provided sufficient well-structured content to access the available marks. Some candidates used repetitive points in their responses and could not therefore access the full mark range. A small number of candidates did not write sufficient text to enable more than 3 marks to be awarded.

(c) **(i)** This question was themed around a proposed tractor tilt indicator system. The majority of candidates did not provide a correct voltage calculation for the potentiometer output at the given position.

(ii) Up to 3 marks were available for candidates who correctly calculated the binary equivalent of an input voltage of 3 V. Candidates were awarded partial marks for determining the decimal equivalent.

(iii) This question was answered well by most candidates although a significant number of responses did not provide a full explanation and were awarded 1 mark.

(d) Most candidates produced annotated circuit diagrams and associated flow charts that correctly met the five specification points for the tractor tilt indictor system. The most common errors were in relation to the common cathode bar array display connection and appropriate checks of the ADC in the flowchart. There were some excellent flow charts which made good use of decisions, sub routines and loops in order to produce the flash sequence for the bar array and buzzer. As always, candidates should be encouraged to annotate their flow charts in order to show their thinking.

Q2 **(a)** **(i)** This question was answered well, although while most candidates referred to a magnet in their explanation a significant number of responses did not refer to its required proximity to the reed switch contacts to close them.

(ii) Responses to this question were generally good with many candidates drawing a correctly labelled circuit diagram. In some cases, there was no indication of where the output voltage was.

(iii) The vast majority of candidates presented an appropriate 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 then full marks cannot be awarded where there are no labels.

(b) A regulated power supply based on a Zener diode was the subject of this question. CA good number of correct circuits were noted but the calculation of the series resistor seemed to prove difficult for some candidates. The most common mistake was the subtraction rather than the addition of load and Zener currents.

(c) **(i)** The detection of the rotation of a disc by means of a phototransistor was the subject of this question. The labelled sketches were varied but generally appropriate and were awarded full marks.

(ii) The responses to this question were limited with many candidates referencing switch 'debounce'. The input to the system was not a switch with contacts but a phototransistor. Many candidates did not refer to the phototransistor input to the Schmitt trigger.

(iii) Most candidates produced accurate circuits that showed how the output voltage from a phototransistor could be connected to the Schmitt.

(d) **(i)** A pleasing number of correctly completed truth tables were noted for this question.

(ii) Candidates were required to write logic expressions for pass and fail LEDS by minimising where possible with the use of Karnaugh maps. The common error was in relation to how the Karnaugh map grouping was executed.

(iii) For Part (iii) candidates were asked to draw a logic circuit for both pass and fail LEDs. Where candidates had incorrectly minimised the logic expression in Part (ii) they were still able to access full marks provided that the logic circuit matched their logic expressions. While many candidates produced correct logic circuits very few used the minimum number of gates as stated.

(e) The calculation of power dissipation for illuminated LEDs was correctly answered by the majority of candidates. Partial marks were awarded for a correct method.

(f) For this question candidates were asked to produce and annotate a PIC based circuit to fulfil the requirements listed in the bullet points. There were a wide range of responses to this question with most candidates scoring between 3 and 8 marks. For full marks candidates were expected to include accurate calculations for appropriate step timings for the stepper motor. Many candidates produced practical and accurate circuit diagrams, however, the most common error noted was the failure to include a means of interrupting the stepper motor program in order to complete the dc motor sweeper arm sequence.

Option B Mechanical and Pneumatic Control Systems

Q3 (a) (i) This introductory question examined candidates' knowledge of safety risks and procedures associated with pneumatic systems. A good number of correct responses were provided.

(ii) A Ball and Socket joint was the focus of this question. Candidates who used an annotated sketch to outline and briefly explain the joint were awarded up to 3 marks. There was a wide range of acceptable sketches, however, some of the explanations were often generic and could be applied to any type of joint.

(iii) There was a significant number of correct responses to this question which required an annotated sketch of the main features of a roller bearing. Many candidates incorrectly sketched ball bearing elements rather than rollers.

(b) (i) This calculation question based on gear and pulley ratios was generally well answered with most candidates showing their method. There was also a significant number of incorrectly calculated velocity ratios. One mark was awarded for a correct method.

(ii) This was another calculation question where candidates were required to calculate the efficiency. Where candidates used an incorrect velocity ratio from the previous question they were not penalised again as the error was carried forward. A significant number of responses used an incorrect formula for efficiency.

(c) The quality of written communication (QWC) was assessed in this question which required an outline of three factors to be considered when selecting an oil. The responses in general were good, however, some candidates produced repetitive responses, and some did not write sufficient text in order to access the full range of marks. A significant number of candidates did not specify an application for their chosen SAE classification.

(d) (i) Chain and sprocket mechanisms were the focus of this question where candidates were asked to outline one advantage and one disadvantage of using this type of system. Most candidates referred to reliability and positive drive as advantages, but many generic disadvantages were submitted.

(ii) This question required candidates to complete a pneumatic circuit to activate an alarm bell by means of a one-way trip valve. There were a small number of correct responses to this question.

(e) (i) Candidates were required to design a suitable mechanism to enable a life raft holder to be elevated. The majority of candidates presented solutions based on bevel gears operating a rack and pinion mechanism. Some solutions were based on a scissor mechanism while others used pulley systems. Many solutions presented had inadequate annotation or lacked detail on how the motor was interfaced to the lifting mechanism.

(ii) An appropriate design for a barrier lifting mechanism was required for this six mark question. Candidates who produced practical and clearly annotated solutions achieved the highest marks. The majority of solutions used an arrangement of cables in conjunction with the motor and pulleys provided on the answer pro forma. There were some annotated responses for designs that did not show how the motor was interconnected with the barriers.

Q4 **(a)** **(i)** Seals were the focus of this question where candidates were asked to select a suitable seal and justify their selection. For rotating shafts in gearbox applications a Garter seal is likely to be the most appropriate type so the high number of candidates who selected an O ring were not awarded the mark.

(ii) A pleasing number of candidates provided excellent annotated sketches of a band brake. The most common error was the omission of a suitable activation method.

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

(b) 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. Clear labelling of group changeover signals and accurate piping lines helped to confirm the candidates' solutions. The most common error was the incorrect piping of the guards to enable a fully operational sequence. A significant number of candidates were awarded full marks or close to full marks.

(c) **(i)** A 5/3 valve circuit was the focus of this question A significant number of responses did not show an appropriate symbol for a 5/3 valve, however, a good number of candidates were able to explain to some degree, how control of this type of valve is achieved.

(ii) The responses to this question which was based on forces in a cylinder were generally inaccurate. A number of methods used incorrect formula and a significant number presented numerical errors. Candidates should be reminded to clearly show their working out as marks can be awarded for partially correct calculations.

(iii) As in previous examination series air consumption questions have been answered well. A significant number of candidates obtained full marks. Where candidates had shown a correct method, marks were awarded for partially correct answers.

(d) Candidates were required to complete a pneumatic/mechanical solution for a design to enable a sign to be rotated when activated by an air bleed. The majority of responses successfully included a means of counter and valve activation however there were only a small number of fully completed systems that used an appropriate mechanism to rotate the sign. Marks could only be awarded to mechanisms that had clearly annotated fixed and moving pivots.

Option C Product Design

Q5 **(a)** The opening part to this question focused on the term right place at the right time. In most cases this was well answered but some candidates needed to expand slightly in their response in order to achieve full marks.

(b) **(i)** Concentrated on the difference between market pull and technology push. This question was well answered by most candidates.

(ii) Focused on the difference between the product life cycle of a fad product and a basic product. In most cases candidates were successful as they were able to explain the main differences associated with both life cycles.

(c) This question focused on the types of consumers who emerge at each stage of the life cycle. In Part (i) many candidates provided two characteristics for opinion leaders, however, in some cases in their response they got these confused with fashion innovators. In Part (ii) candidates were required to distinguish between a fashion innovator and a laggard. This was well answered, however, in some cases candidates got fashion innovators confused with opinion leaders.

(d) This question carried nine marks and required candidates to describe the influence Baylis, Memphis and Apple have had on product design. In a number of cases candidates provided a great deal of generic responses, especially about Apple. Candidates did not focus their responses on the influence these designers and movements had on product design rather they highlighted some facts.

(e) **(i)** Candidates were asked to provide environmental reasons why it is important for product designers and manufacturers to consider the management of waste. This generated a mixed response. In some cases, candidates were able to highlight two different environmental reasons however others often repeated the content from the first reason into the second. In a small number of cases candidates were vague in their responses.

(ii) Focused on addressing environmental concerns through the disposal of products. In some cases, candidates did not relate their answer to what designers/manufactures can do to make their product easier to dispose of and instead gave vague responses that did not fully address the question.

(iii) Required candidates to explain a manufacturing process that may be considered environmentally friendly. This question generated a disappointing response. A number of responses gave generic manufacturing processes with limited justification of how it was environmentally friendly.

(f) Concentrated on CAD and how it could be employed in the design of the hoverboard. The vast majority of candidates answered this question well, highlighting two different ways in which CAD could be used in the design process.

(g) Explain an appropriate pricing strategy for the introduction stage of the product life cycle. The vast majority of candidates were able to give a suitable pricing strategy and justify it. In a small number of cases, candidates were unable to name an appropriate pricing strategy.

(h) Was the last part to this question which provided candidates with the opportunity to undertake a ten-mark design question based on attaching handlebars to a hoverboard. A wide range of solutions were evident. The sketching and annotation were varied throughout, and some candidates gave a more detailed response, and in some case produced imaginative solutions. In a number of responses, aspects of the question were not addressed. Some candidates did not reference how materials and processes were minimised or were suitable for large scale production. Others did not provide a solution that showed how the handlebars were securely connected to the frame. Weaker responses showed limited problem-solving skills.

Q6 **(a)** The first part to this question required the candidates to focus on what is meant by inception. In most cases this question was well answered with candidates being able to explain what the inception stage of the product life-cycle meant.

(b) **(i)** Focused on two characteristics associated with market development. In most cases candidates were able to outline two characteristics. Some candidates provided generic responses that did not fully address the question or got confused with product development.

(ii) This part of the question focused on candidates outlining two characteristics associated with product development. Similar to the previous part of this question, in most cases candidates were able to outline two characteristics. Some candidates provided generic responses that did not fully address the question or got confused with market development.

(c) **(i)** This question generated a good response and required candidates to compare the volume of sales in growth to maturity. This question was answered well by the vast majority of candidates.

(ii) Focused on candidates being able to compare the marketing costs during the introduction to the decline stage of the product life cycle. This question was answered well by the vast majority of candidates.

(d) **(i)** Candidates were asked to outline two characteristics associated with responsible sourcing when selecting a material for a product or component. Some candidates' responses displayed an element of confusion. The term responsible sourcing was not completely understood and in some cases, candidates repeated their previous response.

(ii) This part of the question asked candidates to outline two characteristics associated with recycling content when selecting a material for a product or component. In some cases, candidates did not fully answer the question rather gave generic responses.

(e) Focused on candidates being able to explain two benefits of QRM. This question provided a mixed response. Some candidates gave some brief or repeat answers, others, were able to give two full explanations of the benefit of QRM.

(f) This question generated a good response and required candidates to outline two advantages and two disadvantages associated with sales promotion. This was in most cases a successful question and well answered.

(g) Concentrated on ICT in the delivery of QC systems. Most candidates were able to highlight an appropriate system, however some candidates provided a vague response or got confused with QA. In Part (ii) candidates were required to describe ICT in the delivery of QA systems. Some candidates were able to highlight an appropriate system with others providing a vague response or got confused with QC.

(h) **(i)** Candidates were asked to describe a product which incorporates moral factors in design. In a number of cases candidates struggled to highlight an appropriate product which in turn limited the opportunity to describe how it incorporated moral factors in its design. In some cases, this question was left blank.

(ii) Focused on candidates describing a product which incorporates economic factors in its design. The selection of an inappropriate product hindered some candidates' ability to further address how it incorporated economic factors in its design.

(i) **(i)** This was the first design element of the last question in the paper worth five marks. Candidates were asked to redesign the ballast of a basketball base. In most cases candidates provided an appropriate solution to the question, however, not all aspects of the question were addressed. Some made it easier to move whilst missing the additional support at the position shown by X-X, others provided additional support but did not highlight how it would be easier to move.

(ii) This is the final part to this question and to the section. This again was worth five marks and required candidates to design a housing to store additional components on the reverse of the backboard of the basketball stand. In some cases, candidates did not address specific points from the question in their responses. Some highlighted their design to be securely housed and having outdoor protection but did not address how the items could be quickly removed and replaced after use or vice versa.

Principal Moderator's Report

Assessment Unit A2 2

Coursework: Product, System Design and Manufacture

Overview

This academic year (2022-2023) candidates returned to pre-pandemic coursework specifications, including the making and testing sections. The majority of centres continue to navigate the eCRS system with ease, presenting administration materials to a high standard that enabled the moderation process to be conducted. In some centres eCRS documentation simply contained the score 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 mark awarded. Centres are reminded that the purpose of the moderation process is to ensure that the specification standards are carried across all centres consistently and is not for the moderator to re-mark the work of each candidate. On a number of occasions, moderators found candidate work to exceed the page limit stipulated in subject specification. Centres must ensure that this is addressed when delivering the unit of work, and amended as part of the internal standardisation process if a candidate fails to meet the specification requirements. 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. Review of agreement trial material annually is of paramount importance and presents teachers with the 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.

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 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 sufficient scope for design and development, and ultimately making. Candidates should be wary of selecting a sibling or peer as their client as this can often lead to narrow design opportunities through a lack of detailed discussion about the client needs. In a number of cases, the candidate had selected a client/user with a problem that was very familiar to them. This inevitably led to a narrowing of creativity in the design and development, with the final product appearing similar to many products already on the market but featuring basic "bolt-on" accessories. Analysis of existing products continues to be structured and conducted appropriately by the majority of candidates. Problem identification analysis and design specification continue to be an area for improvement. Design specifications continue to be an area that requires improvement. Measurable, quantifiable and relevant points that draw upon the analysis conducted will enable candidates to explore a range of innovative design solutions going forward. Detailed specification points will also inform the design and development process and allow for the thorough testing of a 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 on work that had received a mark in the top band, yet did not illustrate innovative design and/or high level 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 that were in keeping with A2 level. In some cases, candidates still describe the function of a component rather than a detailed analysis of how this component could potentially be used to solve the problem. Most candidates provided a range of suitable casing designs displaying some excellent CAD skills and some consideration for component placement. Candidates should be discouraged from excessive annotation and reminded that in this section they should be 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 that were clearly guided by their client needs. An infusion of hand graphics, CAD renderings and system/sub-system design that is non-linear should be encouraged at this stage of the design process. Casing designs should contain a range of graphics and/or CAD renderings to illustrate features, component location, ergonomic detail etc. Quite often in this section, casing designs are limited to a CAD rendering with different views and a large proportion of the page dedicated to annotation. Large swaths of text should be avoided. Product design portfolios are still of concern. Often moderators reported a lack of innovation as a result of a limited design opportunity. Centres are reminded that class teacher(s) should give guidance in the planning and realisation of each internal assessment task (section 7.2 "Setting the Tasks"). In some portfolio work it was clear that the candidate had a set design in mind which greatly limited the innovative nature of this section. Candidates should be strongly discouraged from including images of industrial processes and/or large drawings of generic fixings (such as butt hinges). In the best examples, candidates explored a wide range of ideas before selected an appropriate idea for development. Justification for this selection was often included in the candidates' work but could be explored in more detail by clearly linking back to the client needs. A blend of hand sketches and CAD renderings should be encouraged throughout this section, but often there was an overreliance on annotation

which took away from the design process. Top candidates inculcated annotation to support high quality graphics where the latter was the thrust in communicating potential solutions to the problem. Candidates should be encouraged to evaluate their proposals as they progress through this section of work, before coming to conclusions and deciding upon ideas that will be suitable for development. The selection of a proposed solution for development should be explicit.

Development

Unfortunately, moderators, in several cases, are still finding it difficult to agree with marks that have been awarded in this section. The design pathway can often be abandoned at this stage due to preconceived ideas and/or the over development of initial ideas. Often the final design, housing design and/or system demonstrate 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 premediated design proposal or outcome will inevitably limit innovation and ultimately limit the marks that can be awarded. A range of modelling techniques should be evident throughout the development process, making use of CAD packages and physical models to afford candidates with the opportunity of making 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 this adds nothing to development pathway and attracts zero credit. Use of CAD is actively encouraged across the majority of centres with some complex designs evident in a number of cases. Unfortunately some moderators still report that, a number of candidates, are using the same CAD drawing repetitively rather than producing a number of parts or features that can be used to communicate functionality. A candidate 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 be demonstrating how they have developed the circuit design by adding or removing components, how this can impact on the PCB design, then consider the flowchart development. Casing should demonstrate consideration for ergonomic detail and placement of components etc. Often these key elements of a systems design folder can seem contrived and overly annotated. In a similar vein, candidates following the product design pathway, should be discouraged from turning developments into a storyboard exercise whereby the candidate simply outlines the stages of making for various parts. Often candidates will abandon the design and development pathway for more basic, boxy, designs that strike a remarkable resemblance to products currently on the market. Numerical analysis should be infused throughout this section. Some candidates choose to conduct this when the final proposal has been reached but to access the top mark band candidates must be encouraged to produced numeric analysis as part of the development pathway, formulating conclusions and making decisions based upon 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 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 should be logged and not diverge from the final development greatly. Centres are reminded that working drawings should contain realistic measurement data and contain sufficient information for third party manufacture.

Making

In a significant number of centres where a moderator could not agree with centre marks it was the making section that often caused most disagreement. It is important 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 had awarded work top mark band when the system was not fully functional or product lacked innovation. CAM continues to be a popular method of manufacture which enables candidates to realise some innovative and complex design solutions. Some candidates still appear to be driving the design process towards specific CAM process which can limit innovation at times. Centres should be more encouraging of alternatives to CAM processes which are already present in the school workshop. At A2 level it would be expected that work worthy of top marks should be finished to a high standard. PCB's should be secured in the final casing readily accessible for the visiting moderator. Centres are reminded that work deemed to be worthy of the top mark band should be highly functional and should be capable of demonstrating this during moderation. Power and air supplies should be readily available for visiting moderators. Increasing the use of video excerpts have been included to demonstrate a working system which assists during the moderation process. Such videography should not be considered in lieu of a fully functioning product during moderation, but as a way to justify marks awarded, or as part of a product testing exercise.

Testing and Evaluation

This section is often hurried by the candidate due to time constraints and as a result can lack the detail required at this level. Candidates with relevant, measurable and quantifiable specifications often access the top mark band for evaluative exercises. Use of video evidence has become more widespread which aids in the justification of marks awarded. Centres should encourage this practice as it highlights how well the final outcome solves the client's problem, but also assists candidates in the identification of further modifications. Centres are encouraged to build upon AS work through the provision of adequate time and portfolio allocation to discuss further modifications. This should not be overly verbose, but should instead, contain an array of CAD, modelling and annotation which is based upon the results of tests. In the best examples system improvements as a result of the product testing were considered in conjunction with potential housing modifications – this practice should be actively encouraged.

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