GCSE

Rewarding Learning

Chief Examiner's and Principal Moderator's Report

Engineering and Manufacturing

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.

Contents

GCSE ENGINEERING AND MANUFACTURING

Principal Moderator's Report

Internal Assessment Overview

This year we continued to see the streamlining of centres as advice and support information from agreement trials continued to help more centres access the top mark bands. It was clear that in most centres there has been good teaching that had equipped and assisted pupils in responding to the requirements of the Unit 1 tasks.

Administration was generally good and most centres presented their sample in rank order with the e-candidate cover sheets. Portfolios were submitted both digitally and in paper format.

Assessment Unit 1 Design

Section A: Analyse the Design Brief & Research

Candidate work generally addressed the criteria directly, however, the depth of analysis varied greatly. Some candidates presented excellent analysis that not only addressed the main aspects of the task, but they also went further and suggested their direction of travel as they planned how they would begin to research and move towards a solution. These deeper thinking skills allowed candidates to access higher marks. Research was good and it was encouraging to see that most centres focused on quality of research rather than high volume of pictures. Research commentary by candidates indicated there was good learning taking place and that their understanding had been enhanced due to the research taking place.

Section B: Specification

As advised in agreement trials in 2021 and 2022, candidates generally produced specifications that were comprehensive and that were definitive, measurable and justified. Centres now understand that with this one page attracting a maximum of fourteen marks, it needs to be both detailed and show a technical understanding of the design success criteria.

Section C: Generation of Design Concepts

The sketching work was of a good standard, however, there was an increase in candidates producing surplus sketches of screws, bolts, hinges, caster wheels and various other standard components, which attracted no marks and did not contribute value to the design process. These 'filler' sketches should be discouraged by centres and instead candidates should be encouraged to produce simple 2D/3D sketches of how parts fit together and their understanding of how a part could be manufactured. It is also worth reminding centres that the assessment criteria states that this section must be produced "using freehand techniques", so there should be no form of CAD assisted sketching or tracing in this section. Such practice must be discouraged as it contravenes the assessment criteria and will be treated as malpractice in the same manner as tracing and templating.

Section D: Development of the Chosen Solution

The standard of computer aided drawing work across all centres was generally of a high standard and indicated the great teaching of CAD that is occurring within schools. However, some candidates producing high quality CAD, omitted adding in the essential annotation to explain what their thought process was and how the product met the specification and how it had been developed. It is also worth reminding centres that candidates without any calculations in this section cannot access the top mark band and that working drawings need to be drawn in third angle.

Section E: Manufacturing Proposal

This section was completed well by candidates, and it was encouraging to see that more candidates were adding in sources from where their pricing was sourced from. This added further integrity to candidate work and allowed candidates to produce more realistic costings. There was still evidence of candidates adding in generic diagrams and flowcharts that added no depth to their analysis, nor did it indicate that the candidate had any more technical knowledge. Some candidates also overlooked their reasons for material choices and did not consider indirect costs that would add to the cost of manufacture. The use of exploded 3D CAD and tables was generally very good and allowed candidates to demonstrate the complexity of the product they had designed. However, just a brief reminder candidates do not need to catalogue and justify every small component in their design, if the four or five main parts of the design are analysed, described and costed, this is more than sufficient for this unit. Some candidates were trying to catalogue 14-15 parts which was a lot of work and sometimes led to a lot of repetition.

Chief Examiner's Report

Assessment Unit 2 Production

Overview

The overall performance of candidates was not in line with previous iterations of this unit, most candidates submitted both parts of the task but in comparison to previous years there seemed to be a less coherent response to the task. The 2023 task was slightly more straightforward than the previous year in terms of the complexity of the part profiles but with similar quantities of cutting and drilling as previous years.

Candidates in many cases had produced parts which looked like the parts in the task but had not hit the higher mark bands in terms of the accuracy of their work. Candidates need to understand the concept of dimensional tolerance when producing practical pieces and be able to check their work is within 0.5mm of the stated dimensions if they wish to achieve the higher mark band.

The candidate responses achieved marks across a wide range and demonstrated a range of levels of skill and accuracy. Candidates made a more accurate response in the steel part of the task, the level of accuracy and finish on the acrylic parts tended to be of lesser quality than the steel part.

The acrylic part was in many cases poorly addressed, the cutting and finishing of the part to the dimensions presented lacked the required precision and accuracy to attain the higher mark bands in much of the work. Cutting materials and filing to a line to produce an accurate dimension would be a general area for development for students addressing this specification. Producing accurate marking out and precisely positioning centre punch marks and drilling holes is also an area that would benefit from additional practice.

The acrylic part seemed to be problematic for many candidates which gave evidence that the candidates had not been able to work effectively with acrylic in terms of cutting and finishing the material using hand tools. Teachers should ensure that candidates have wide experience and capability in cutting and finishing the materials to a given dimension the with hand tools and equipment listed in the specification in preparation for the examination. The past examination papers provide a range of tasks in a range of materials and should be used to prepare candidates for the range of skills and the pace of work required in the Unit 2 exam.

Steel part

Q1 **(i)** 6 off 5mm diameter hole locations. All candidates produced holes of the correct diameter having selected the correct diameter drill, but a significant proportion of the candidates failed to drill these holes in the correct location to achieve the top mark band. Marking, center punching and drilling holes accurately is a core skill in the Unit 2 exam and candidates should be confident and well-practiced in addressing this type of question.

Q2 **(i-iii) M5 threaded hole location.**

This question was well addressed with most candidates producing a good quality thread.

Q3 **(i-iv) Linear dimensions x 6.**

These dimensions were in most cases well addressed with students on average scoring 12 marks from an available 18 marks with some excellent work submitted.

Q4 (i-ii) Quality of finish on edges and faces.

Students were asked to produce a draw filed finish on their work and to remove the sharp edges in this question but much of the work was not finished to the required level to achieve the top mark band.

Acrylic part

Q5 (i-v) Holes on acrylic part.

This question was well addressed with most candidates achieving the higher mark bands.

Q6 (i-iv) Linear dimensions x 6.

The profile of the acrylic part was generally not well addressed by candidates. The acrylic part seemed to have been problematic particularly in the production of the cutouts on each side of the part. Marking on the parts indicated that the candidates had read and understood the part geometry but were not cutting and filing to the marks they had produced. Cutouts have been a theme in this exam in previous series and candidates should be given the opportunity to become confident in marking out and cutting such features in wood metal and plastic parts.

Q7–10 The cutout was poorly addressed or absent in much of the work presented, as were the remaining features of the acrylic part. Around half of the acrylic parts were incomplete and submitted without the part being bent to shape.

Assessment Unit 3 Materials, Processes and Systems

Overview

All questions in the examination paper proved accessible. Assistant Examiners reported that, in their assessment, the layout and language of the paper was appropriate for GCSE level.

Some candidates attempted all questions within the paper, however, there was a significant number of candidates who made no attempt to answer parts of the paper. In general, the quality of responses varied in their level of detail with many answers bearing little or no relevance to the question. A review of completed scripts suggests that candidates had sufficient time to complete the paper within the allocated timeframe.

Q1 This was a challenge for some candidates. The majority were able to identify a property of low carbon steel but then struggled with the following questions relating to injection moulding. Many candidates were able to state why injection moulding would be used. However, for the annotated sketch there were very poor responses, many of which were unrelated to injection moulding. Most candidates could not identify the microswitch from the graphic, but many made reasonable responses about why a lawnmower should comply with safety standards.

Q2 Many candidates could give reasons why mass production was suitable for the lawnmower. Most candidates, however, were unable to successfully answer about computer-integrated manufacturing (CIM). Many appeared to be confused with computer-aided design (CAD) and responses were based on how to produce 3D designs of the lawnmower rather than how CIM would be used in the manufacture of lawnmowers. Approximately one third of candidates were able to give a suitable definition for tolerance. Many candidates in responding referred to stresses and strains placed upon components as opposed to dimensional tolerances and the impact of these on manufacturing. Very few candidates were able to state one or both tools needed to measure the blade.

Q3 This mathematical, problem-based question presented significant challenge for many candidates. Part 3(b) was especially poorly answered with only a minority of candidates achieving the maximum four marks for this question. Candidates who made clear attempts to respond to these questions were awarded some credit for their early workings-out. Candidates should be encouraged by centres to display all elements of their working-out to enable examiners to award partial credit where it is clear the candidate has shown a level of knowledge or understanding worthy of credit. Examiners will always work to reward learning where it has been evidenced. It was clear that it was the practical application of mathematics and associated thinking skills that presented the most significant challenge for candidates with this question. Centres should be aware that preparedness for questions of this type should form a key component of the teaching and learning of future cohorts in preparations for this examination unit.

Q4 This question required candidates to use a number of key skills to articulate their ideas through sketches and annotation. Responses were mostly limited here with very little annotation attempted from many candidates. The feature in question was specific and gave opportunity for a range of creative responses to the design situation but very few took on the challenge. Some candidates work showed a lack of engagement with the pre-release materials. There were some well-prepared candidates who produced very good responses, however, no candidates were able to achieve the maximum marks available.

High quality responses required candidates to know and functionally understand suitable mechanisms involved for adjusting the height of the cutting deck parts and, in turn, apply their communication skills to articulate this understanding. Centres should encourage candidates to engage with the pre-release material to research possible design scenarios, materials and associated mechanisms.

Q5 Most candidates attempted this question; however, no candidates were able to achieve maximum marks. Responses were mostly limited for this question. Many candidates were able to successfully demonstrate reasons for hardening the lawnmower blades but very few candidates were able to explain the hardening process. Responses were either entirely incorrect with no relevance to the question or responses for that section were left blank. This question allowed for candidates to demonstrate their capabilities in the use of written form, style, spelling, punctuation, grammar and technical vocabulary. This presents a challenge for many candidates and is a core skill worthy of more precise focus with future cohorts for some centres.

Q6 Very few candidates were able to score any marks for this entire question. Many responses were blank or completely incorrect. It did appear that there was a lack of knowledge of symbols, their function and the physical appearance of components.

Q7 The moments calculation was similar to other calculations, few candidates were able to achieve the full two marks. However, most candidates were able to score at least one mark. Future cohorts should be encouraged to show all working-out to allow examiners to award partial credit. Candidates would also benefit from preparation on converting units to achieve maximum marks for similar style questions. Many candidates seemed to be confused between finishing techniques, many describing dip coating rather than powder coating. Many candidates could identify the properties of oak but had less success in explaining the equipment required to cut and shape the material. Only a few were able to identify the industrial machine processes involved in the shaping of the oak beam.

Q8 Responses were very disappointing for the differences between hardwoods and softwoods. Most candidates were unable to produce a satisfactory response. However, many candidates were able to suitably identify reasons for using MDF. Moreover, many candidates were able to calculate the volume and density of material used but most struggled in converting units into meters cubed.

Q9 Very poor responses with many left blank. The candidates struggled to identify the process or materials in the table. Few were able to give suitable reasons for choice of plastic and very few candidates were able to correctly expand the BSI acronym. Most candidates however were able to identify at least one material property for the car wheel rims.

Q10 Most candidates were able to correctly outline post-accident procedures. However, most candidates had no knowledge of a go-no-go gauge. Many responses were either irrelevant or left blank. Part (c) was poorly answered. Very few candidates were able to successfully distinguish between direct and indirect manufacturing costs.

Q11 Some candidates were unable to successfully describe the features of the assembly line but in most cases this question was attempted unlike other sections of the paper. Candidates should be aware that “faster” and “easier” type answers will not be enough to gain credit and should be encouraged to identify characteristics and explain their understanding or demonstrate their knowledge. Most candidates were able to produce suitable benefits for using robotics with very few responses left blank. Part (c) however, was poorly answered and most candidates failed to identify factors for using computer-aided engineering (CAE).

Contact details

The following information provides contact details for key staff members:

- **Specification Support Officer: Nuala Tierney**
  (telephone: (028) 9026 1200, extension: 2292, email: ntierney@ccea.org.uk)
- **Officer with Subject Responsibility: Judith Ryan**
  (telephone: (028) 9026 1200, extension: 2133, 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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