GCSE

Rewarding Learning

## Chief Examiner's and Principal Moderator's Report

# Engineering and Manufacturing

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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# GCSE ENGINEERING AND MANUFACTURING

# Principal Moderator's Report

## Subject Overview

The response across the three units in GCSE Engineering and Manufacturing showed an improvement in candidate performance across all three units.

The design folders demonstrated good development and strong CAD skills, but the specification section generally remains an area for improvement, as many candidates produced work lacking the required depth and relevance.

There was a significant improvement in the work submitted for the Unit 2 exam, with all centres providing a coherent response. Both parts of the task were submitted, and most of the features were completed. Unit 2 is a challenging examination, and the key to success for candidates is to focus on the individual features they must produce and to adopt a structured approach to completing the tasks.

Most candidates attempted all questions within the Unit 3 paper, which is a significant improvement compared to the performance of candidates in 2023. The quality of responses varied in their level of detail; however, most candidates demonstrated a good understanding of the course. An area for improvement would be the use of the pre-release material, which should be utilised as a focus for preparation for Section A of the paper.

# Assessment Unit 1 Design

## Moderation Overview

Centres entered for the GEM11 Unit 1 controlled assessment produced a good variation of portfolio work that addressed both the tablet stand and poultry feeder tasks. Administration was generally good; however, some centres did submit work that was not bound properly, which slowed down the moderation process. Most centres presented their samples in rank order with the e-candidate cover sheets. Portfolios were submitted both digitally and in paper format.

Centres must ensure that the work presented in candidates' folders belongs to the candidates listed. Submitting work that belongs to another candidate could lead to issues of maladministration or malpractice for the centres.

## Section A: Analyse the Design Brief and Research

Candidates' work generally showed good intent in addressing the criteria set out in the pre-release tasks. This was demonstrated through a variety of formats; some candidates used block diagrams, others employed spider diagrams, and some utilised mind mapping formats. Within these frameworks, there was a range of quality in the analysis. Some candidates provided in-depth explanations of their initial thoughts and applied their technical knowledge effectively, while others offered more superficial analysis.

Research has largely improved across all centres, with most now opting for a quality analysis of two or three products rather than a high volume of products with descriptive comments. This shift has had a positive knock-on effect on the later sections of the portfolio.

## Section B: Specification

Candidates are producing better quality specifications that are more technical, measurable, and justified as detailed in the specification. However, there was evidence that many candidates are confused about how to present specifications, resulting in several descriptive statements explaining what they were going to do rather than outlining statements of intent. A few specifications were also written in the past tense, and it is important that centres remind candidates to write these as success criteria, not as descriptions of what they did. It was encouraging to see many candidates beginning to justify their target weights and costs and using their research to support their justifications.

## Section C: Generation of Design Concepts

The 'generation of design concepts' section was generally presented in three or four-page formats and displayed a wide range of capabilities. It was encouraging to see that most centres were aware of the standard and were able to mark their candidates' work in line with the agreement trial material. There were some excellent examples of rendering and the use of exploded 2D and 3D diagrams, which effectively communicated the technical understanding of the designs being presented. This type of communication should be encouraged, as it greatly enhances the quality of candidates' work.

## Section D: Development of the Chosen Solution

The use of CAD in this section continues to be of a very high standard across centres. Candidates are generally using CAD drawings more effectively, with insightful annotation often evident. However, some candidates produced excellent CAD work without any annotation. It is important that centres encourage pupils to explain their thought processes and use CAD drawings to highlight how development occurs. A helpful teaching resource has been produced to guide candidates through this section, available on the CCEA website. Centres are encouraged to use this resource when teaching, as it helps candidates understand how marks are allocated.

## Section E: Manufacturing Proposal

There was another noted improvement in this section, and it was evident that candidates had accessed the support material online, which positively impacted the manner in which their work was presented. It was encouraging to see that candidates had included sources for proposed costings and that most candidates' planning for production addressed the assessment criteria. However, some candidates tended to include generic flow charts and comments that offered no insight into their understanding of the process. Candidates should be actively discouraged from using 'page fillers' that often dilute the quality of their work.

# Chief Examiner's Report

# Assessment Unit 2 Production

## Overview

The overall performance of candidates was encouraging and showed a marked improvement on the previous year. The vast majority of candidates submitted both parts of the task, with most of the features attempted in both sections. The 2024 task was consistent with previous tasks in terms of the complexity of the features, with similar quantities of cutting and drilling as in previous years.

In many cases, candidates produced parts that resembled those in the task but did not achieve the higher mark bands due to issues with accuracy. Candidates need to be cautious when interpreting the drawings provided for the task, as some of the steel angle pieces were mirrored, and some holes were incorrectly marked from the inner face of the angle rather than the outer face, as indicated on the drawing. Candidates should focus on marking and cutting materials to the specified linear dimensions, accurately marking and drilling hole locations, and checking the accuracy of their work as they complete each feature.

The candidates' responses achieved marks across a wide range and demonstrated varying levels of skill and accuracy. Candidates generally performed more accurately on the wood part of the task, while the level of accuracy and finish on the steel part tended to be of a lower quality than on the wood part.

Teachers should ensure that candidates gain extensive experience and capability in cutting and finishing a variety of materials to specified dimensions using the hand tools and equipment listed in the specification, in preparation for the examination. Past examination papers offer a variety of tasks in different materials and should be used to prepare candidates for the range of skills and the pace of work required in the Unit 2 exam.

## Linear Dimensions

**Q1** Length of the steel angle (200mm).

Many candidates did not trim the supplied material to size and appeared to assume that the material had been provided in the finished size.

**Q6** **(i)** Rectangular cutout (130mm).

**(ii)** Rectangular cutout (50mm).

**(iii)** Rectangular cutout (20mm).

**(iv)** Rectangular cutout (40mm).

**(v)** Rectangular cutout (10mm) x 2 off.

The rectangular cutout on the steel angle was the most challenging feature in the exam, and some candidates did not attempt to produce it, though there was evidence of some excellent work. Cutouts and internal shapes have been a common theme in this unit, and candidates should be given opportunities to build confidence in addressing these types of features across a range of materials.

**Q11** **(i)** Channel cutout (50mm).

**(ii)** Channel cutout (75mm).

**(iii)** Channel depth (10mm).

**Q12** Position of the fingers (25mm) x 4off.

The wood part was well executed by the candidates, and the quality of the marking and cutting to linear dimensions was evident in most of the pieces submitted.

## Hole Positions

**Q3** **(i)** 4 off 10mm hole locations.

**(ii)** 10mm hole diameters.

**Q4** **(i)** 4 off 4mm hole locations.

**(ii)** 4mm hole diameters.

The holes in the steel part were generally well executed. Most of the work submitted had all the holes produced within tolerance, achieving appropriate marks. However, some candidates marked the holes from the inside face of the angle, resulting in the holes being out of position by 3mm.

**Q9** **(i)** 2 off 8mm hole locations.

**(i)** 8mm hole diameters.

The holes in the wood part were generally produced very accurately, with many candidates attaining full marks.

## Radii

**Q7** **(i)** 30mm Radius.

**(ii)** 20mm Radius.

**Q13** 20mm radius

The radii on both parts were generally very accurate, with most candidates achieving two or more marks for each of the specified radii. However, some candidates produced the radii in the wrong location on the steel part.

## Chamfers

**Q2** 30mm x 30mm chamfer (30mm x 2 off).

**Q5** **(i)** 8mm x 12mm chamfer (8mm).

**(ii)** 8mm x 12mm chamfer (12mm).

**Q10** 50mm x 50mm Chamfer (50mm) x 2off.

Chamfers were produced to a high standard by most candidates, with the majority achieving between 4 and 6 marks for each chamfer.

## Finish

**Q8** **(i)** Finish on all part edges.

**(ii)** Finish on part faces.

**Q14** Quality of finish

As a rule, the finish on the wood part was far superior to that of the steel part. Many candidates did not deburr the holes on the steel part.

# Assessment Unit 3 Materials, Processes and Systems

## Overview

All questions in the examination paper proved accessible. Examiners reported that, in their assessment, the layout and language of the paper were appropriate for GCSE level. Most candidates attempted all questions within the paper, which represents a significant improvement compared to the performance of candidates in 2023. The quality of responses varied in detail; however, most candidates were able to demonstrate a good understanding of the course. 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 unable to identify the mechanism as a linkage. While many candidates were able to state why aluminium alloy is used for the mechanism, they struggled to define the term stiffness. However, there were some good responses for the annotated sketch of pressure die casting. Most candidates attempted the diagram and were able to achieve at least half of the marks. Centres should encourage candidates to include annotation in future manufacturing process diagrams.

**Q2** Most candidates were able to provide reasons why nylon was a suitable material for the casing. However, they struggled to successfully identify the manufacturing process used to make the casing. It was encouraging to see that most candidates could identify safety precautions when using the scroll saw. However, many were unable to identify suitable materials for the table from the graph. Centres should encourage candidates to fully engage with the pre-release materials, as all the information about the examined materials is included in the pre-release document.

**Q3** These mathematical, problem-based questions presented a significant challenge for many candidates. Part (a) was particularly poorly answered, with only a small number of candidates achieving the maximum seven marks for this question. Candidates who made clear attempts to respond to these questions were awarded some credit for their initial workings-out. Centres should encourage candidates to display all elements of their working-out to allow examiners to award partial credit where it is evident that the candidate has demonstrated a level of knowledge or understanding worthy of recognition. Examiners will always strive to reward learning where it has been evidenced.

In Question 3 Part (b), most candidates failed to achieve full marks as they did not use the density equation correctly. It was evident that the practical application of mathematics and associated thinking skills posed the most significant challenge for candidates with this question. Centres should ensure that preparedness for questions of this type is a key component of teaching and learning for future cohorts in preparation for this examination unit.

**Q4** This question required candidates to use a range of key skills to articulate their ideas through sketches and annotation. Responses were generally satisfactory, with many candidates making an attempt at annotation. The feature in question was specific and allowed for a variety of creative responses to the design situation, and many candidates embraced this challenge. However, some candidates' work showed a lack of engagement with the pre-release materials. Nonetheless, there were well-prepared candidates who produced excellent responses, with a small number achieving the maximum marks available. High-quality responses required candidates to understand and functionally apply suitable mechanisms for adjusting the tension of the scroll saw blade and the method for attachment, and to use their communication skills to articulate this understanding effectively. Centres should encourage candidates to engage thoroughly with the pre-release material to research possible design scenarios, materials, and associated mechanisms.

**Q5** The majority of candidates successfully attempted this question, demonstrating a good understanding of CAD/CAM and robotics, with a variety of interesting insights into the topic. However, a small number of candidates clearly did not understand the question and instead described the operation of the scroll saw. This question provided an opportunity for candidates to showcase their abilities in written form, style, spelling, punctuation, grammar, and technical vocabulary. This presents a challenge for many candidates and is a core skill that some centres should focus on more precisely with future cohorts. Assistant examiners reported that a number of responses were difficult to mark due to poor handwriting.

**Q6** Only a small number of candidates were able to score any marks for this entire question. Many responses were either blank or completely incorrect. It appeared that there was a lack of knowledge regarding symbols, particularly pneumatics components. Additionally, there was a general lack of understanding of shape memory alloys and smart materials among the majority of candidates.

**Q7** Many candidates were unable to identify the milling machine as the workshop machine. There was a wide variety of responses. However, most candidates were able to identify at least one marking-out tool. Most candidates successfully identified the measurement tools used to determine the depth and width of the pocket, and there were several strong responses to the tolerance question. Nonetheless, many candidates struggled to articulate the use of the quality control chart effectively.

**Q8** Responses were very mixed regarding forming processes and joining methods. Most candidates were able to determine the reasons for using iron for the metalwork vice successfully. However, many candidates struggled to provide satisfactory responses for the characteristics of mass production. Most responses were either too general or contained one-word answers such as "cheaper" or "quicker." Candidates should be encouraged to provide more detailed explanations for their answers.

**Q9** Responses for Part (a) and Part (b) were very poor, with many left blank. Centres should encourage candidates to include as much working out as possible to allow examiners to award credit where feasible. The responses for Part (c) were considerably better, with most candidates able to achieve all three marks.

**Q10** Material properties were generally well answered, with a basic understanding evident from most candidates. The question on the elastic limit, in particular, was answered very well.

However, in Part (b), most candidates seemed to misunderstand the question and described why the park frame is galvanised rather than explaining the process of galvanising.

**Q11** Part (a) was well answered, with many candidates able to describe the advantages of pick and place machines. However, most candidates struggled with Parts (b) and (c). In Part (b), many candidates described the uses of different renewable energy sources rather than explaining how machine and process efficiency can reduce energy costs. Furthermore, most candidates confused CAE with CAD/CAM, resulting in an inability to gain marks in Part (c).

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