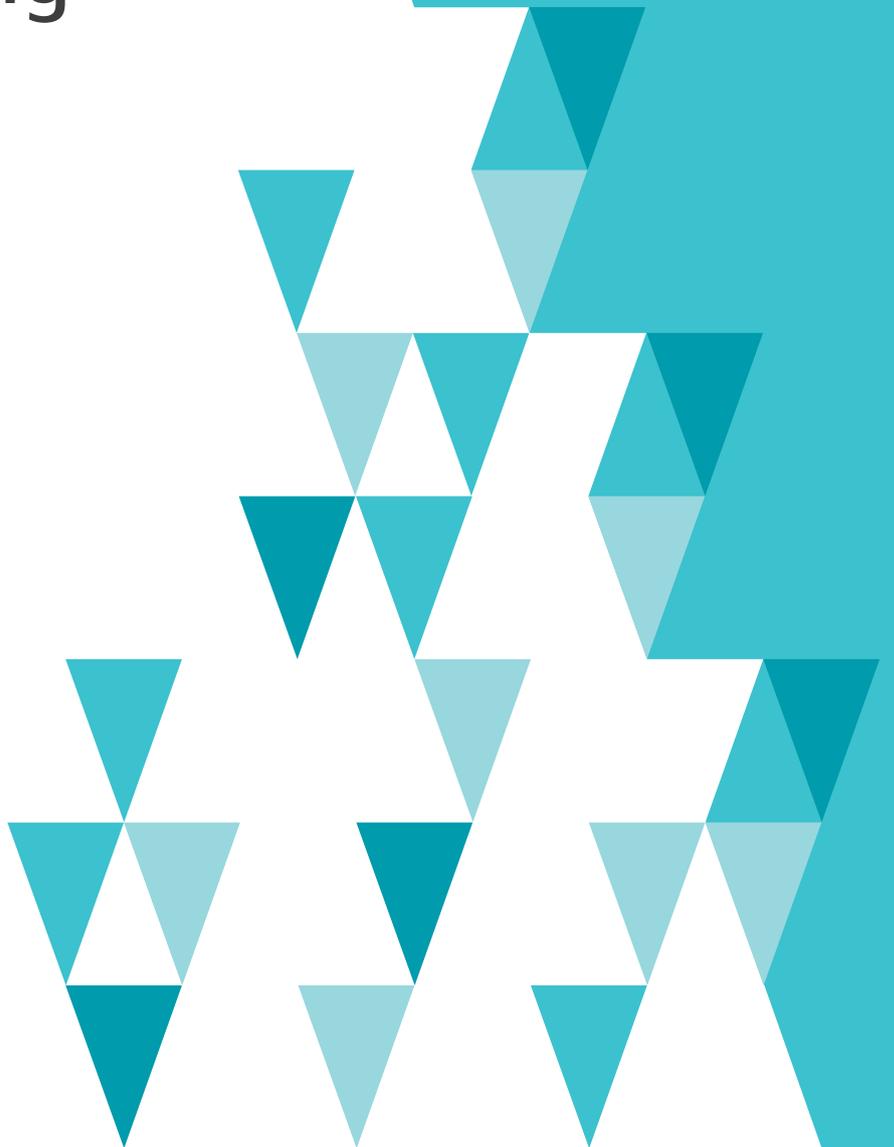


GCSE



**Chief Examiner's and  
Principal Moderator's Report  
Engineering and  
Manufacturing**

Summer Series 2019





## Foreword

This booklet outlines the performance of candidates in all aspects of this specification for the Summer 2019 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](http://www.ccea.org.uk).



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# GCSE ENGINEERING AND MANUFACTURING

## Overview

This is the second year and first awarding cycle of the GCSE in Engineering and Manufacturing. This specification presents a range of valuable opportunities and challenges to those candidates engaging with the qualification. Centres and teachers are to be commended for their renewed and ongoing efforts and dedication in preparing candidates for the range of assessments within the revised specification.

Candidates were generally well prepared across the examination units, although some candidates' capacity to apply the key skills, integral to the Revised Northern Ireland Curriculum, explicitly of Using Mathematics, Problem Solving and, in general, Thinking Skills is often under developed.

A significant component of the revision of this specification is the application and mode of assessment of practical skills within GEM21. This provides an invaluable opportunity for candidates to develop knowledge and understanding through the practical application of these skills and be rewarded for this learning journey through the unique assessment tool within the GEM21 examination. Centres are strongly encouraged to see, and articulate to candidates, the links between the three units of this specification and to design learning opportunities that foster the development of knowledge, understanding and skills in a cohesive and codependent manner. The 3 units should be viewed and, where possible, taught as a heavily interwoven programme of learning rather than three siloed assessment pathways.

Centres should be encouraged by the outcomes of this first award and to engage with the range of support materials compiled to support this Specification.

## Principal Moderator's Report

### Assessment Unit 1      Design

#### Overview

In the second year of the revised specification, candidates offered a diverse range of responses to the domestic food waste container and skateboard service station design opportunities, presented in the 2018/19 pre-release material. There was evidence across the entries that centres had taken guidance on board from the October 2018 Agreement Trial and the majority of centres presented the portfolios in a manner that allowed moderation to take place efficiently. It is essential that centres ensure that candidates do not exceed 12 pages and the suggested page layout in the support material. It is also important that candidates work independently and that they do not submit work that contains generic templates. Portfolios were generally bound or stapled and the large majority of candidates had made the effort to clearly define the five sections of the portfolio. Candidates communicated using a wide variety of techniques and generally demonstrated good competency in spelling, punctuation and grammar.

#### Analyse the design brief and research

In the 'Analyse the design brief and research' section, there was a plethora of responses that used a wide range of appropriate techniques to successfully meet the demands of the specification. It was encouraging to see candidates directly address the requirements of the brief as laid out in the pre-release material. This resulted in work being less generic in

response and enabled more candidates to access the higher mark bands. The research of existing products, tended to divert more towards 10 or 12 products from search engines that had generic commentary, rather than the recommended 3-4 products with detailed analysis on materials, joining processes and how the products have been assembled. In this section candidates would benefit from identifying key design considerations that could be more meaningfully used to inform their specification and design work.

## **Specification**

In the 'Specification' section, there was generally a significant improvement upon the work entered last year and centres had clearly focused on improving candidate understanding of the requirements to produce a technical specification. Many candidates presented specifications that had clearly defined success criteria, using terminology that gave genuine intent to their efforts to address the essential criteria, e.g. the product should/the product will/the product must. Most candidates also demonstrated an ambition to generate more measurable criteria and this aided them in being more objective in the manner in which they addressed the problem. This gave their reasoning a technical edge and appropriately defined boundaries to design within. There was still evidence of several candidates offering opinions, feelings and rigid plans in this section. Candidates need to be reminded that this is not appropriate, as it cannot be marked as a specification and work produced in this format is likely to achieve marks within the limited mark band.

## **Generation of design concepts**

The 'Generation of design concepts' section seen candidates structure their work better and good centre guidance had resulted in very few candidates presenting CAD in this section. Centres are reminded that this section should use freehand sketching only to communicate design concepts. As only hand sketches are allowed in this section, the work differentiated by outcome. Candidates largely made a good effort to address the criteria and to provide justifications for their suggested material choices and manufacturing processes. It was disappointing to see some candidates present good quality designs that were sparsely populated and had limited annotation. These often lacked any evidence of partial development or technical understanding of how they would produce the design proposal. Candidates being marked in the top mark bands should not only be competent communicators graphically, but also be competent in the manner in which they communicate their understanding of what they have presented through the medium of 2D/3D sketches, cross sectional drawings and technical annotation. There was evidence that aesthetically pleasing work often induced more marks than was merited.

## **Development of chosen solution**

The fourth section 'Development of chosen solution' has the most substantial mark allocation of 28 marks. In several centres, candidates did not present work that merited top band marks, when they had been placed in this band. There was still a significant proportion of candidate work that was absent of any calculations and this resulted in difficulties endorsing marks within the top mark band for these candidates. However, some centres had taken the guidance on board from the agreement trial and had produced a range of calculations that were purposeful and meaningful to the development process. Across most centres there was some excellent CAD being produced in this section that really informed the development and the confirmation of dimensions, materials and appropriate finishes. Some candidates did not utilise CAD effectively to illustrate out how their product had developed, nor how it was evolving towards becoming a viable product for batch production. Working drawings were generally presented well and had most of the key dimensions identified, however there was a significant minority of candidates who did not present their drawing in 3<sup>rd</sup> angle as stipulated in the specification.

## Manufacturing proposal

In the final 'Manufacturing proposal' section, there were very few centres making the same error as last year by encouraging candidates to produce an evaluation section with suggested improvements. Several centres had taken advice from the agreement trial on board and had made a conscientious effort to produce a proposal for manufacture that considered elements of batch production for 500 units. Some candidates had even considered implications for mass/continuous production, and although this is not an expectation (nor does it accrue any further marks), it was encouraging to see candidates reflect their understanding of this part of the specification content from Unit 3. However excessive use of tables by some centres and candidates often resulted in repetition of justifications and reasoning. Copying and pasting was an issue with a lot of candidates as they sought to 'fill pages' rather than properly analyse the manufacturing issues surrounding production. A significant number of candidates were marked in the top mark band by centres, yet failed to produce detailed referencing to materials, components and production methods. This practice cannot be endorsed by the moderation team.

At the agreement trial the marking activities and the commentary on the specification offered an opportunity for teachers to identify appropriate benchmarking and progress towards meeting the requirements of the Unit 1 specification. This had a positive impact, with fewer issues with centre marking. This is a trend that we seek to continue and we strongly encourage teachers delivering the Engineering and Manufacturing specification to attend the agreement trial in October 2019 when further support will be offered. Additional support material will continue to become available on the GCSE Engineering and Manufacturing microsite.

[www.rewardinglearning.org.uk/microsites/engineering](http://www.rewardinglearning.org.uk/microsites/engineering)

# Chief Examiner's Report

## Assessment Unit 2      Production

### Overview

The overall performance of candidates was encouraging and the majority of candidates made a coherent response to the paper and submitted all three parts of the task. The candidate responses achieved marks across a wide range and demonstrated a range of levels of skill and accuracy.

It was evident that candidates were prepared for the practical skills involved and in using the equipment named in the pre-release material but that there may have been a weakness in reading the engineering drawing and in working to the  $\pm 0.5\text{mm}$  tolerance. It was evident that the vast majority of candidates were competent in addressing the demands of this paper.

Candidates made a more accurate response in the metal parts of the task, the level of accuracy and finish on the steel parts tended to be of higher quality than the acrylic part.

The acrylic part was generally marked out with accuracy but the cutting and finishing of the part to the dimensions presented lacked the required precision and accuracy to attain the higher mark bands in some 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. Many candidates failed to produce accurate bends on the acrylic part which indicates a lack of confidence in using a line bender to produce accurate bent acrylic parts for some candidates.

The parts submitted were generally close to the dimensions stated and all parts were generally completed by the candidates which gave evidence that the candidates had understood the drawings and were able to follow them to produce all three parts of the examination.

### Additional subject specific advice/guidance

Having reviewed the work submitted in response to the Unit 2 examination it is recommended that teachers focus on the areas of marking out and producing work that meets the  $\pm 0.5\text{mm}$  tolerance band on given dimensions. Teachers should ensure that candidates have wide experience and capability in working with the materials and equipment listed in the specification in preparation for the examination.

#### Q1 Threaded bar

- (i) Measure the length of the threaded portion.
- (ii) Straightness and surface finish of the thread.
- (iii) Overall length of the threaded bar.
- (iv) Quality of finish on the threaded bar.

The length and quality of the thread was generally good with the majority of candidates achieving the higher mark bands but around half of the candidates failed to cut and finish the bar to the specified length and remove the sharp edges. It appeared that some candidates may have assumed the bar was the correct length and that the only operation to be completed on this part was to produce a thread. Teachers should impress on candidates the need to check all dimensions to conform to the parameters stated on the drawings.

- Q2** (i) M5 x 0.8 threaded hole in the steel plate.  
 (ii) Fit of the threaded bar when fitted to the threaded hole.  
 (iii) Squareness of the threaded bar when fitted to the threaded hole.

The majority of candidates made a very good response to this question, the threads on both parts were clean and accurate and within the tolerance for squareness and position on the steel plate.

**Q3 and 4**

- Q3** (i) 7mm Hole diameters.  
 (ii) 2 off 7mm holes correctly located.

- Q4** (i) 4mm Hole diameters.  
 (ii) 4 off 4mm holes correctly located.

All candidates produced holes of the correct diameter having selected the correct drill but a small number of candidates submitted parts where these holes had been omitted. A significant proportion of the candidates failed to drill these holes in the correct location. A greater focus on marking out and location of hole positions with a centre punch is required so that candidates can access the higher mark bands in this type of question.

**Q5, 9 and 11**

**Q5** 12.5mm radius on the steel plate.

**Q9** 15mm radii on the acrylic part.

**Q11** 10mm radii on the acrylic part.

Almost all candidates produced the radii detailed in the examination paper but much of the work presented highlighted that many students did not attain the highest mark bands due to a lack of skill in filing to a line and in draw filing a curved edge. The radii on the steel part were completed in general to a higher standard than those on the acrylic part. Given that radii are common features on planar materials I would suggest that candidates should practice marking out techniques and producing accurate and precise radii on a range of materials types and thicknesses.

**Q6** Overall Length of drilled plate (100mm).

Candidates made a good response to this question, around half of the steel plates achieved the higher mark bands but many of the pieces fell outside of the lower limit and received no marks. This indicates that candidates, in some cases, are not reviewing or self-assessing their own performance in relation to achieving key dimensions on their work.

**Q7 and 13**

- Q7** (i) Quality of finish on edges of steel part.  
 (ii) Quality of finish on faces of steel part.

**Q13** Quality of finish on edges of acrylic part.

The quality of finish on the steel parts tended to be superior to that of the acrylic part. A significant number of the acrylic parts were submitted in an incomplete and unfinished state.

**Q8** Length of acrylic part at top cut out (100mm dimension).

This question produced a good response with a high proportion of candidates scoring in the higher mark bands.

**Q10** Height of the parallel portion of the bent acrylic part (16mm dimension).

The bends in the acrylic part generally presented a challenge to the many of candidates. Given that the bend lines and correct overall width of the material was given on the exam paper the limited response from many of the candidates indicates a lack of confidence and precision in producing bends to tight tolerances.

**Q12 (i)** Acrylic part bent to the correct width (46 mm).

**(ii)** Sides bent square to the base.

The angle of the bends were generally very accurate with the majority of candidates achieving the higher mark bands.

**Q14** Location of the holes in the acrylic part.

The locations of the 7mm hole and 6mm holes in the acrylic part were accurately produced in the majority of the candidates work. This indicates that candidates were confident in marking and drilling acrylic. All candidates produced holes of the correct diameter having selected the correct drill but a small number of candidates submitted parts where these holes had been omitted.

## Assessment Unit 3      Materials, Processes and Systems

### Overview

This was the first GEM31 examination paper for the revised specification in Engineering and Manufacturing. All questions in the examination paper proved accessible with no evidence of any questions eliciting a markedly low response rate from candidates. The vast majority of candidates attempted all questions within the paper. In general, the quality of responses varied from very detailed to inadequate and a review of completed scripts suggests that candidates had sufficient time to complete the paper within the allocated timeframe.

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

**Q1** This question was, generally, very well answered by most candidates. The majority of candidates however were unable to state the name of the CE mark within Question 1(c)(i).

Despite the fact that this section of the examination is based on Pre-Release Material (PRM), a surprising number of candidates were unable to suggest an appropriate finish for the main frame of the rowing machine within Question 1(a)(ii). It is important that candidates consider the specific constraints associated with the product and its associated context as presented within the PRM as part of their preparations for this examination.

**Q2** Most candidates were familiar with standard parts and assembly-line production and some of the various benefits accrued through their use within engineering and manufacturing production and associated with the rowing machine. Similarly, many candidates were clearly able to identify examples of direct and indirect costs. Many candidates, however, were unable to define, beyond examples, the more wide-reaching definitions sought in response to Questions (c)(i) and (d)(i).

- Q3** This question elicited a broad range of responses from candidates and it is clear that this mathematical, problem-based question presented significant challenge for many candidates. Question 3(c) was especially poorly answered with only a minority of candidates achieving the maximum four marks for this question. The majority of candidates who made clear attempts to respond to this question 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. Many candidates overcomplicated Question 3(c), unable to deduce that the volume of material saved was the volume of a single cuboid; a comparatively straightforward calculation to those attempted by many candidates. It was clear that it was the practical application of mathematic skill and associated thinking skills that presented the most significant challenge for candidates with this question, not the mathematical skill per se. These applications of mathematical capabilities, coupled with thinking and problem-solving skills are critical elements of the Northern Ireland Curriculum; of efficient engineering and manufacturing; and, in turn, of this specification. Given the ubiquity of these skills within industry, 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 responses through sketches and annotation and elicited a wide array of outcomes. Many candidates used their knowledge gained from research of the PRM to display their understanding of engineering and manufacturing principles through the use of 2D sketches and annotation. There was a number of well-prepared candidates with excellent responses right through to only basic and often inadequately communicated responses. High quality responses required candidates to, firstly, know and functionally understand suitable attachment and detachment possibilities and, in turn, apply their communication skills to articulate this understanding. Marks accrued within this question were often limited as a correlating function of these interrelating skillsets.
- Q5** A wide range of responses were presented in answer to this question. Responses ranged from excellent to poor. The vast majority of candidates attempted this question and the full range of marks was used. Not all candidates were able to give relevant and detailed quality control checks and discuss how these checks ensured user safety. A number of candidates did not discuss how the quality checks linked to the safety of the user. This question allowed for candidates to demonstrate their capabilities in the use of written form, style, spelling, punctuation, grammar and technical vocabulary. It is clear that this presents a challenge for many candidates and is a core skill worthy of more precise focus with future cohorts for some centres.
- Q6** This question was generally well answered with the exception of Question (d)(i), (ii) and (iii) where a surprising majority of candidates were unable to state the correct name for each wood joint.
- Q7** The majority of candidates were able to identify properties and characteristics relevant to the material type and calculate the surface area as required.
- Q8** Generally, many candidates responded well to this question stating the correct manufacturing process used to manufacture the products shown in the images. Similarly, candidates generally had a good understanding of the benefits of alloying metals. Various levels of knowledge relating to the galvanising process were demonstrated with only a few candidates describing the process fully and articulating suitability within the presented application of the metal watering can.

- Q9** Most candidates were familiar with levers and the principle of moments with only a small number of candidates labelling the traditional balance scale incorrectly. The majority of candidates identified the rivet in Fig. 13 with only some being able to give two reasons why this joining method was suitable within this context.
- Q10** In Question 10(c), some candidates found it difficult to link how wider dimensional tolerances could reduce production costs and were not specific in their response. In Question 10(b) it was both apparent and surprising, given the skills to be developed within the GEM21 unit of this specification, that a significant number of candidates were unfamiliar with and appeared to have little or no experience of using a micrometer and/or vernier calipers. In turn they were unable to describe two functional differences. Those candidates that were able to, confidently identified two specific differences and it was apparent that responses were grounded within their reflections of prior, hands-on use of these items of equipment. The interconnectivity of knowledge, understanding and skills within GEM11, 21 and 31 is a key strength of this specification. It was apparent that candidates from centres seemingly making explicit links between knowledge and understanding from this unit and congruent skills within the other two units can provide a more experience-informed response to this question type. Helping candidates to construct links between the content of the three units is to be encouraged.
- Q11** Candidates were well prepared for this type of question and were able to answer 11(b) and especially (c) comprehensively.

## Contact details

The following information provides contact details for key staff members:

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