CAMBRIDGE NATIONALS

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Examiners' report

ENGINEERING DESIGN

J831, J841

R105 January 2022 series

Version 1

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers are also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

R105 series overview

R105 is one of four units that make up the Cambridge National in Engineering Design. Candidates will either work towards the Award to complete R105 and R106, or the Certificate, R105, R106, R107, and R108. R105 is the only externally examined unit with the other units being centre assessed. There were 25 parts within the six questions for January 2022. To do well on this examination paper, candidates need to have gained and demonstrated knowledge and understanding of processes involved in designing engineered products, and knowledge of prototyping drawn from practical skills in drawing, computer modelling and model making. Candidates should be able to apply this knowledge in a written description of design processes and considerations.

Many candidates attempted most of the questions on the paper, although there were exceptions among some lower ability candidates. It is not uncommon for candidates at the lower end of the performance range to omit the 6-mark question designed to assess QWC (Quality of Written Communication), as well as specification content knowledge and understanding. Question 5c* in this series was no exception. Teachers should encourage candidates to make some attempt at all questions, not least the QWC question within their preparation for the written exam.

Candidate performance varied across the range of abilities. Some part questions were answered well across the ability range and likewise there were parts which were less well answered by many candidates. As in previous series, candidates did not always read the question thoroughly. There was evidence of misunderstanding of the terms used within the questions, possibly due to candidates having not considered the correct context of the question and/or some evidence in gaps in knowledge.

Candidates who did well on this paper generally did the following:	***Candidates who did less well on this paper generally did the following:***
• Understood key terms used within the questions. • Were able to demonstrate knowledge and understanding of the impact of designs on manufacturing processes. • Demonstrated understanding of the manufacturing processes involved in the manufacture of engineered products, such as design for injection moulding, scale of production and how these impact on design. • Were able to show understanding of the sequencing of the design cycle and understanding of what takes place within each cycle. • Demonstrated knowledge and use of symbols used on products.	• Showed limited knowledge of the 6Rs and sustainable design within Question 1 and Question 3 (a). • Gave simplistic responses such as 'cheap', 'effective', 'saves time', without some justification to show understanding. • Did not make links between manufacturing processes and their influence on the design. • Did not correctly give responses related to the terms used within the specification. These include 'error proofing', 'sustainable' and 'additive manufacture'. • Did not always read the question and question parts carefully, and repeated given information as their answers.

Question 1 (a)

1 (a) The 6R's are an important element of sustainable design. Complete the table below by adding the missing parts of the 6R's.

1	
2	Reuse
3	
4	Refuse
5	
6	Rethink

[3]

A high number of candidates across the ability range could not correctly name the missing three names/terms of the 6Rs. The order in which the correct terms could appear in the table was not part of the marking criteria, although a small number of candidates appear to have interpreted that the order was relevant.

Exemplar 1

1 (a) The 6R's are an important element of sustainable design. Complete the table below by adding the missing parts of the 6R's.

1	Recycle
2	Reuse
3	Remake
4	Refuse
5	~~Recycle~~ ~~Redesign~~ redesign
6	Rethink

[3]

There appeared to be a gap in knowledge of this part of the specification. Answers given for parts 1 (b) (i) and 1 (b) (ii) were often presented less well than expected for early questions designed to ease candidates into the paper.

Question 1 (b) (i)

(b) Describe what is meant by the following parts of the 6R's.

(i) Refuse

.....

.....

..... **[2]**

For parts 1 (b) (i) and 1 (b) (ii), candidates should give two valid points or one justified point. Lower scoring candidates gave responses that were not sufficiently related to the 6Rs and/or described the meaning of the term 'refuse'/rethink as a general meaning.

In Exemplar 2 the candidate needed to give a justified response for the second mark in this 1 mark example.

Exemplar 2

(b) Describe what is meant by the following parts of the 6R's.

(i) Refuse

Refusing or not allowing to use non-recyclable materials

[2]

Question 1 (b) (ii)

(ii) Rethink

.....

.....

..... **[2]**

In Exemplar 3 the candidate has given a fully justified response worthy of the full 2 marks available.

Exemplar 3

(ii) Rethink

'Rethink' is used in engineering as a part of the 6R's and it describes rethinking production methods to make the production of an item more sustainable using more renewable sources of energy. **[2]**

Question 1 (c)

(c) Describe the impact of non-recyclable materials on the environment.

.....

.....

.....

.....

.....

..... **[3]**

This question part was very well answered with a high proportion of candidates at all levels achieving at least 2 marks, and more often all 3 available marks. Candidates gave good and valid descriptions with justification of the impact of non-recyclable material on the environment.

Question 2 (a) (i)

2 **Fig. 1** shows a mass-produced bucket produced using injection moulding.

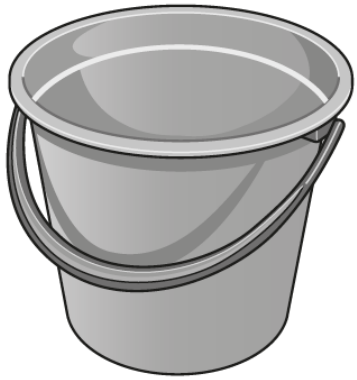


Fig. 1

(a) **(i)** Give **one** way that ease of manufacturing has been considered in the design of the bucket shown in **Fig. 1**.

..... **[1]**

This question part was not as well answered as expected. Some candidates repeated the question stem above the image, answering that the bucket is 'mass produced' or 'injection moulded'.

	AfL	It is important that candidates take the time to read the introduction to the question before reading the instruction and attempting to answer.

Question 2 (a) (ii)

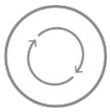
(ii) Give **two** benefits, other than ease of manufacturing, when using injection moulding.

1 .....

2 .....

[2]

This question part was generally poorly answered. A high proportion of candidates gave simplistic responses not worthy of marks such as 'It's quick' and 'It's cheap'.

	**AfL**	Candidates are required to give a concise response such as 'Reliable because all parts will be identical' or 'Cost efficient when produced in high volume' rather than simplistic one- or two-word responses, in demonstrating knowledge to be given marks.

Question 2 (a) (iii)

(iii) Name **three** manufacturing processes, other than injection moulding, suitable for mass production.

1 .....

2 .....

3 .....

[3]

Most candidates were able to give at least one correct response to this part. Some candidates repeated 'injection moulding' already given within the question. Candidates correctly gave a wide range of acceptable processes used within manufacturing. A small number of candidates did not read the question properly and incorrectly gave responses related to the scale of production i.e. 'Batch', 'Mass', etc.

Question 2 (b)

(b) Explain why manufacturing processes can have an impact on the design of products.

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.....

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.....

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.....

.....

..... **[4]**

This question part was answered less well by many candidates. Candidates who achieved the higher marks for this part were able to demonstrate understanding of engineering processes used in manufacturing products, and how the processed can impact on the design, such as 'materials used', 'finish', and the scale of production required. Although not necessarily required, where candidates can give specific examples of manufacturing processes, this can help demonstrate understanding. A relatively commonly communicated misunderstanding evident in candidate responses in this and previous exam series is that mass/high-volume production results in low quality.

Question 3 (a)

3 As part of the design cycle, designers need to consider the impact a new product will have during its manufacture and useable life.

(a) Name **three** areas of sustainable design that would be considered when evaluating a new product.

1 .....

2 .....

3 .....

[3]

This question part was generally answered less well by candidates across the performance range. Candidates generally gave vague responses such as 'Materials', not worthy of credit without some further details such as 'Materials that can be recycled'. In some cases, candidates gave responses unrelated to the correct meaning of the term 'sustainable' in the context of the question.

Question 3 (b)

(b) Name **two** processes, other than evaluation, that occur in the validate phase of the design cycle.

1 .....

2 .....

[2]

This question part was reasonably well answered with most candidates giving at least one correct response. There was, however, a high incidence of candidates incorrectly answering with 'error proofing', which within the specification is part of the optimise phase rather than the validate phase.

Question 3 (c)

(c) Name **one** other phase of the design cycle.

..... **[1]**

Most candidates were able to correctly name one other phase of the design cycle. Some lower achieving candidates incorrectly gave 'validate' as their response, which is already stated within part 3 (b). It is important for candidates to consider the question as a whole, not just the sub-question part when answering questions that ask for 'other' or 'other than' such as in this question part, Question 2 (a) (ii), and Question 6 (c), to avoid repeating content that has already been given within the question.

Question 3 (d)

(d) Explain the importance of evaluating a product before sale.

.....

.....

.....

.....

.....

..... **[4]**

Candidate performance for this question part was variable. Many candidates gave responses related to sales, or profit, instead of the anticipated answers in the mark scheme which are focused on evaluating against the design brief, specification, user requirements and functionality.

Question 4 (a)

4 Pre-manufactured components can be used during the manufacture of products.

(a) Give **two** reasons why designers may use pre-manufactured components.

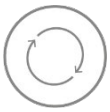
1 .....

2 .....

[2]

As in previous exam series, candidates confused pre-manufactured parts with standard components. While both feature within the specification, candidates are required to understand the difference between the two terms, and how their use contributes to ease of manufacturing.

Many candidates achieved no marks or 1 mark for this question part. Answers such as 'cheaper' or 'cost less' require a justification to be given marks.

	**AfL**	It is important for candidates to understand the difference between standard components (common fasteners, etc.) and pre-manufactured parts such as replaceable units, unit/sub-assemblies, plug-in circuit boards, etc.

Question 4 (b) (i)

(b) (i) Give **two** advantages of using prototyping during the development of a new product.

1 .....

2 .....

[2]

This part question was well answered by most candidates. Candidates gave an appropriate range of good responses demonstrating clear understanding of the advantages of prototyping.

Question 4 (b) (ii)

(ii) Name **two** types of additive manufacturing technology that could be used for producing a prototype.

1 .....

2 .....

[2]

Very few candidates gave two correct answers for this part with less than 50% giving one correct example.

Additive manufacturing technology was added to the revised specification for first teach from September 2020 and first assessment in 2021. Candidates across all levels were only able to give '3D printing' as a correct type of additive manufacturing, demonstrating that there may be a gap in teaching beyond the generic term of '3D printing'; the mark scheme included six different types of additive manufacturing technology. There were very small number of exceptions where candidates correctly named two types.

Many candidates across all levels of performance gave 'CAD' and other incorrect answers.

Question 4 (c)

(c) Explain why designers should consider the supply chain when developing a new product.

.....

.....

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.....

.....

..... **[4]**

This question part was less well answered than anticipated. The mark scheme allowed candidates to give answers across a wide range of factors including sustainability related to the designing, however some candidates gave answers related to distribution of products, and/or incorrectly demand for product, and sales.

Question 5 (a)

5 Product testing is an important part of developing a new product.

(a) Give **one** method that can be used for each type of product testing.

Virtual

.....

Physical

.....

[2]

This question part was answered variably by candidates. Generally, candidates were able to give correct responses for virtual methods of testing, however less for correct physical testing.

Question 5 (b)

(b) Give **two** reasons why designers would suggest ways to improve the design during the validation phase.

1 .....

2 .....

[2]

This question part was well answered, with most candidates being able to give valid responses.

Question 5 (c)

(c)* Discuss, using examples, how error proofing is used in the design of products.

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..... **[6]**

?	**Misconception**	Many candidates across the performance range did not give answers related to the correct meaning of the term 'error proofing'. These candidates incorrectly responded with answers related to faults in general, faults found during testing, etc. Error proofing examples across all levels of candidate performance were mostly limited to the UK mains cable plug, USB leads, and colour-coded AV plugs/leads. Where possible, candidates were given marks for recognition of the relevance to product/user safety, but too often there was no other understanding of error proofing demonstrated within the answer.

Question 6 (a)

6 Below are two product symbols.

Symbol A

Item removed due to third party copyright restrictions

Symbol B

(a) Name the symbols.

Symbol A

.....

Symbol B

.....

[2]

This question part was reasonably well answered with most candidates achieving 1 mark for correctly naming the recycle mobius symbol. Fewer candidates correctly named the Fairtrade symbol although many did.

Question 6 (b) (i) and 6 (b) (ii)

(b) (i) Draw the trademark symbol below.

[1]

(ii) Name **one** other symbol used to safeguard a design or a product.

..... **[1]**

Candidate performance across the ability range was variable for question parts 6 (b) (i) and 6 (b) (ii). There did not appear to be a correlation between candidates who were able to correctly draw the trademark symbol in part 6 (b) (i) and those who were able to correctly name another symbol to safeguard a design in part 6 (b) (ii).

?	**Misconception**	Many candidates incorrectly interpreted this term as meaning 'safety' rather than protecting the design/design ideas (intellectual property) as part of regulations and safeguards within the unit specification. Many candidates incorrectly gave responses such as 'flammable', 'age appropriation …' and other answers used for the safe use of the product.

Question 6 (c)

(c) Give **two other** reasons why symbols are applied to products.

1 .....

2 .....

[2]

For this question part, many candidates incorrectly gave one or both answers related to safeguarding the design, although some of the same candidates answered part 6 (b) (ii) correctly.

Question 6 (d) (i)

(d) **Fig. 2** shows a symbol found on products.

Fig. 2

(i) State the name of the symbol in **Fig. 2**.

..... **[1]**

Many candidates across the mark range were able to correctly name the symbol in this part.

Question 6 (d) (ii)

(ii) Explain the purpose of the symbol in **Fig. 2**.

.....

.....

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.....

.....

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..... **[3]**

This question part was well answered with most candidates achieving 2 or 3 marks. The mark scheme provided the opportunity for candidates to achieve marks for a range of explained points and or examples, although examples of the CE mark being applied was not a requirement to receive marks.

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