OCR
Oxford Cambridge and RSA

CAMBRIDGE NATIONALS

Examiners' report

ENGINEERING DESIGN

J831, J841

R105 January 2020 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 is 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 can be downloaded from OCR.

Paper R105 series overview

R105/01 is the examined unit for the Cambridge National Award and Certificate in Engineering Design and contributes 50% and 25% respectively towards the final qualification. The papers and associated specification provide theoretical underpinnings to the internally assessed units of the qualification.

In recent series of the R105: *Assessing client briefs, specifications and user requirements* examination paper, the maturity of the specification has demonstrated that centres are preparing candidates for the paper more effectively, resulting in candidates being able to access the paper well and gain marks on the vast majority of topics covered in the specification.

As mentioned in previous reports to centres following past series, centres should cover the entirety of the content set out in the specification. Once the content has been covered it is advised that centres spend some time preparing candidates for the examination using the past papers for the examination. This should allow candidates to answer the whole paper with sufficient understanding and depth. There are key areas of the specification where candidates' understanding is not as fully developed as it needs to be to access the questions. There are particular examples of this that will be explained in detail throughout this report.

Centres and candidates are also reminded to address the command verbs in the questions. At times it is clear that candidates are not always answering questions in the style expected of the command verb. For example, when a question command verb is 'Explain' or 'Describe' candidates are answering with one-sentence answers. This limits their ability to access the full marks available for the question.

i	**OCR support**	Candidates could be directed to the OCR Cambridge Technicals Command Verbs guidance document available from the OCR website: https://www.ocr.org.uk/Images/273311-command-verbs-definitions.pdf This explains the meaning of command verbs and their use in assessments, along with examples. While intended for the Cambridge Technicals, this will nevertheless provide useful guidance on command verbs used in the Cambridge Nationals.

Question 1 (a)

1 (a) Designers complete a range of tasks throughout the design cycle. The tasks are shown in the list below.

A	Test the product
B	Create a brief
C	Create a prototype
D	Develop a design specification
E	Evaluate the design

Put the tasks in the correct order. One has been completed for you.

				E

[4]

This question required candidates to put a series of task in order based on the order they would be completed in the design cycle.

On the whole candidates were able to gain some credit by getting multiple tasks in the correct order however, many candidates did not gain the maximum mark available because they mixed up two of the tasks.

Centres are reminded to make sure candidates know the order of the design cycle and its associated tasks as defined in the unit specification.

Overall, the question provided a positive opening to the paper.

Question 1 (b)

(b) Designers will also complete research to inform the design of new products.

State **three** ways a designer can undertake research.

1 .....

2 .....

3 .....

[3]

The majority of candidates were able to gain some credit from this question by stating ways that designers can undertake research such as, surveys, focus groups or analysis of existing products.

Where candidates did not gain full credit, they gave responses that related to topics that may be researched and not ways a designer would carry out the research.

Question 1 (c)

(c) Explain why further research may be required later in the design process.

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.....

.....

.....

.....

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

Responses to this question varied, with some candidates able to gain credit while a large number missed the focus of the question. This question required candidates to consider why further research may be needed later in the design process, not why a designer would undertake research before commencing the development of a design. Where candidates were able to gain credit, they were able to explain how an error may occur, that testing may highlight a problem or that customer needs may change throughout the design process requiring the designer to carry out further research to find solutions.

Where candidates did not gain credit, responses from candidates focused on research without consideration of why this may occur later in the design process. Therefore, responses may have contained reference to identifying the target market or looking at trends rather than the requirement to find out further information.

Question 2 (a) (i)

2 Fig. 1 shows a portable speaker.

Fig. 1

(a) Describe a product requirement for each of the following areas that should be included in a design specification for the portable speaker.

(i) working environment

.....

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

Responses to this question varied with many candidates not clearly demonstrating an understanding of the working environment. Many candidates provided answers relating to the use of the speaker within an office or workplace with others focusing on how the sound from the speaker would need to fill a room. In other cases, candidates confused the term working environment with environmental issues. These responses were not worthy of credit. Where candidates did gain credit, they provided responses that considered the environment the speaker would be used in and how it would need to withstand environmental conditions such as moisture or being durable enough to withstand being dropped.

	AfL	Centres are reminded to make sure they cover the specification in detail and make sure candidates fully understand the meaning of the terms listed in the specification.

	Misconception	Some candidates confused the term 'working environment' with environmental issues or an office based working environment. The working environment focuses on where the product will be used not issues associated with those examples given above.

Question 2 (a) (ii)

(ii) ergonomics

.....

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

The vast majority of candidates were able to gain credit for responses to part (ii) of this question, demonstrating a good understanding of ergonomic design considerations that should be included in a design specification for the speaker. Candidates who gained credit were able to consider the size and position of the buttons alongside design considerations that aided portability and operation such as weight or geometry of the design.

Where candidates did not gain credit, responses focused on features of the product but without consideration of ergonomics. In other examples, candidates repeated portability from the stem of the question but without reference to the ergonomic features that made this possible.

Question 2 (a) (iii)

(iii) lifecycle

.....

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

A large number of candidates were able to gain credit for responses to part (iii) with many demonstrating a solid understanding of product lifecycle with regard to criteria in a design specification. Candidates were able to provide responses related to end of life considerations such as disassembly and recycling.

Where candidates did not gain credit, responses focused on ensuring the product had a long life but did not provide specific considerations that could form criteria in a specification.

Question 2 (b)

(b) Give **one** other product requirement that should be included in a design specification.

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

Responses to this question varied with some candidates providing a valid response that was related specifically to the product requirements category of a design specification as detailed in the unit specification for the qualification. These responses contained requirements such as appearance, function or features.

Where candidates did not gain credit, they either provided vague responses or they provided response that were from other categories of a design specification.

Question 2 (c)

(c) Describe how a design specification is used to ensure the product can be successfully manufactured.

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

A large number of candidates were able to gain at least partial credit here because they understood some of the reasons why a design specification can support successful manufacture. Where credit was given, candidates provided responses that described how the design specification sets out the key criteria that the product must achieve. They understood how this can be used by manufacturers as a check list to make sure that any performance requirements and product features are incorporated into the product. They also understood how the criteria in the specification is defined based on extensive research and knowledge of the client or user needs alongside operating conditions and the associated elements of the product that are needed for the product to perform.

Where credit was not given, candidates did not relate their responses to how the design specification assists manufacturing and instead described or listed some of the criteria included in a design specification.

Exemplar 1

In the design specification, there would be guidlines about how the product should be made for example the tolerances, if the tolerances are not specific or in the specification the product may not work properly and the people don't know what tolerance it needs making to. Also it should state the method of production because some methods require certain geomatries [3]

Exemplar 1 provides a detailed description of how a design specification is used to make sure a product can be successfully manufactured.

The candidate has provided a high level response that demonstrates an understanding of a range of features within a design specification that help the manufacturer to successfully produce the product. These are comprehensively explained.

The response gained maximum credit.

Question 3 (a)

3 Testing is an important part of the design process.

(a) Give **two** reasons why designers test a product.

1 .....

2 .....

[2]

This question received positive responses from candidates, with large numbers able to gain credit. The vast majority of candidates understood that designers test products to make sure they are safe or to make sure they work correctly.

Where credit was not given, candidate responses were vague or only one example was provided.

Question 3 (b)

(b) State **two** methods that designers could use to test a product.

1 .....

2 .....

[2]

This question was well answered by candidates with a large majority able to gain credit. Candidates who gained credit gave specific examples of testing methods such as destructive and non-destructive testing examples.

Where candidate did not gain credit, they gave reasons for testing a product such as those required for part (a) or they only gave one example, missing out on the second mark available.

Question 3 (c)

(c)* Discuss why designers would evaluate a product during the validate phase of the design cycle.

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

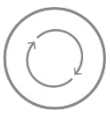
Candidates were required to show understanding of why designers would evaluate a product during the validate phase of the design cycle through a discussion that assesses their quality of written communication.

Candidate responses varied in quality, but overall, candidates were able to demonstrate some understanding of why designers would evaluate a product during the validate phase of the design cycle.

Able candidates provided a discussion that clearly discussed the importance of validating a product before putting it on sale and developed this to explain the consequences of launching a product without completing this stage of its development. Responses considered how evaluation could support conformity to standards, product safety and reliability. Candidates who gained credit were also able to discuss how evaluation allowed them to reflect on the development of the product to improve processes in the future.

Where candidates did not gain higher levels of credit in their responses, they provided short responses and did not develop the points they made.

Where candidates gained minimal credit they did not write in extended prose therefore failing to meet the requirement of the extended written response asked for in this type of question.

	**AfL**	Centres are reminded to make sure they cover the full scope of the specification in depth to make sure candidates achieve maximum marks. As mentioned previously, centres are reminded to develop candidates' ability to write extended responses. Some responses were written in bullet point format which, although some excellent points were made, candidates could not achieve higher marks as they are being assessed on their ability to write extended prose and not just their knowledge of the topic in the question.

Exemplar 2

edges on a toy. Designers evaluate products to see how successful they have been and how could they improve it so that it will attract a wider market, and then resulting in more sales and money and a better reputation. They also evaluate products to see if it matches the design brief and specification and also safety regulations and legislations so that they are able to put it on the market and not get prosecuted if a customer gets injured by the product. [6]

Exemplar 2 provides an extract of a coherent, well-structured written response supported with multiple examples of why designers would validate evaluate a product during the validate phase of the design cycle.

The full response gained credit at Level 3.

Question 4 (a) (i)

4 Scale of production is an important manufacturing consideration.

(a) Name **one** production process that would be suitable for each scale of production.

(i) one-off

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

Responses to this question varied. Where candidates gained credit, they were able to provide an example of a production process that would be suitable for a one-off product such as 3D printing.

Where candidates did not gain credit, they either gave responses related to mass manufacturing or they named a product that could be made as one-off rather than the process that would be used.

Question 4 (a) (ii)

(ii) mass

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

Responses to this question were more generally more positive than those given for part (i). Candidates appeared to have a greater understanding of mass production processes than those used for one-off products.

Where candidates gained credit, they successfully named processes such as injection moulding that are applicable to mass production activity.

Where candidates did not gain credit, they generally gave vague responses referring to machines without a specific process or, similarly to responses in part (i) gave examples of mass-produced products.

Question 4 (b) (i)

(b) Suggest **one** product that would be manufactured in each scale of production.

(i) one-off

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

Part (b) of question four developed on part (a) by now asking candidates to provide an example product that may be produced in a specific scale of production. Part (i) required candidates to provide an example product that would be manufactured as a one-off.

Many candidates were able to gain credit here and provided responses such as stadiums or bridges. Where candidates did not gain credit, responses were given that referred to mass-produced products.

Question 4 (b) (ii)

(ii) batch

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

Responses to this question varied with candidates either demonstrating an understanding of batch production or losing credit in a similar way to part (i) by stating a product most commonly produced by mass production. Where candidates gained credit, they were able to give responses in line with examples given in the mark scheme.

Question 4 (b) (iii)

(iii) mass

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

In part (iii), candidate responses were stronger, demonstrating a stronger knowledge of mass-produced products. The vast majority of candidates gained credit here with examples such as cars or standard components. In the small number of cases where credit was not given, candidates stated mass production processes rather than products produced at the correct scale or no response was given.

Question 4 (c)

(c) State **one** reason why manufacturing plans should consider the scale of production early in the design cycle.

.....

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

Responses to this question varied in quality. Where candidates gained credit, they were able to give responses that demonstrated understanding of how consideration of the scale of production when producing a manufacturing plan allow for an estimation of costs or time. Some candidates understood how the scale of production can affect the production process that is selected or even how this can subsequently affect component geometry.

Where candidates did not gain credit, responses tended to focus on a more simplistic interpretation of the considerations such as knowing how many products to make. These responses did not gain credit because this is implicit in the scale of production.

Question 4 (d)

(d) Explain why processes used for mass production may not be suitable for producing a one-off product.

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

Question 4(d) required candidates to explain why mass production processes may not be suitable for producing a one-off product. Candidates were either able to gain no credit for their responses or achieved high marks on the question based on their understanding of different types of processes.

Where candidates gained credit, they understood how mass production processes require large amounts of initial investment for machinery or tooling that is offset over time as large quantities of products are produced and then sold. They developed their answer by explaining how because of this investment, many mass production processes then become prohibitable expensive and impractical for one-off products as the costs cannot be offset when only one is produced.

Where candidates did not gain credit, responses focused on the perception that one-off products are better quality than mass-produced products. This is incorrect and therefore was not worthy of credit.

?	**Misconception**	Some candidates provided responses that were based on a perception that products produced as one-off are better quality than those produced in mass production. Mass production, automation and the use of machinery can achieve excellent levels of accuracy and quality, in many cases, better than products or components that may be made by hand.

Exemplar 3

For example, when injection moulding, A mould is made which is used thousands of times to make the exact same product which is very cost efficient. However making a mould for a one off item would not be cost efficient as it would cost alot for a mould to be made for 1 thing. Therefore something like 3D printing would be better for one off production, but it wouldn't work in mass production. [4]

Exemplar 3 provides a detailed answer explaining why processes used for mass production may not be suitable for producing a one-off product. The candidate has demonstrated a sound understanding of how the costs associated with tooling and machinery for mass production are not suitable or cost-effective for producing components in small quantities.

The response gained maximum credit.

Question 5 (a)

5 New and emerging materials can improve product performance.

(a) Name **three** new and emerging materials.

1 .....

2 .....

3 .....

[3]

Question 5(a) required candidates to name three new and emerging materials. A large number of candidates were able to gain partial credit by naming at least one new and emerging material such as carbon fibre. However, very few candidates were able to name three new and emerging materials. Where candidates did not gain credit, responses referred to common materials that could not be classed as new and emerging or they did not provide three responses.

	AfL	Centres are advised to make sure candidates develop knowledge of multiple 'new and emerging' materials. A large number of candidates could provide responses about one new and emerging material and they appeared to have good knowledge of more common engineering materials. Only a small number of candidates were able to name multiple new and emerging materials.

Question 5 (b)

(b) Describe, using an example product, how a new and emerging material has improved the performance of a product.

Example product .....

Description .....

.....

.....

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

Question 5(b) developed on responses to part (a) by asking candidates to describe, with the aid of an example, how a new and emerging material has improved the performance of a product.

Where candidates had demonstrated knowledge of new and emerging materials in part (a), this question was answered well. It illustrated many candidates' deeper understanding of how new and emerging materials have improved product performance. For example, how the use of carbon fibre in vehicles has improved performance or fuel efficiency.

Where candidates did not gain credit, they were unable to provide a suitable product with relevant description or spoke about the application of a material that was not classed as new and emerging. In some of these cases, where strong responses were given, some credit may have been given.

Exemplar 4

Example product ..... Racing cars eg: Ferrari F1 cars.....

Description ..... By using carbon fibre now for the chassis, this increases rigidity and improves safety for the driver. But more importantly reduces weight, thus making the car faster. ..... **[3]**

Exemplar 4 provides a sound description, using an example, of how a new emerging material has improved the performance of a product. In this example, the candidate has described how the use of carbon fibre has improved safety and performance in racing cars.

The response gained maximum credit.

Question 5 (c)

(c) Give **two** ways that production costs can be affected by material selection.

1 .....

.....

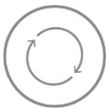
2 .....

.....

[2]

A large number of candidates were able to gain credit for their responses to this question, by providing valid ways that production costs are affected by material selection. In these examples, candidates understood how some materials may be harder to process than others or how specialist machinery or tooling may be required.

Where candidates did not gain credit, responses focused on material cost and a presumption that the more expensive the material, the more expensive production will be, and vice versa.

	**AfL**	Centres are advised to make sure candidates develop a deeper understanding of costs and how, in many cases, the factors affecting cost can be complex. For example, many candidates assumed that the more expensive a material, the more expensive production will be. This is not always the case. Plastics for example are a cheap material but are extremely expensive to process due to the requirement for specialist machinery or tooling to form the material.

Question 5 (d)

(d) Name **two** other factors that can affect production costs.

1 .....

2 .....

[2]

Many candidates were able to gain credit for their responses to this question and successfully named at least one additional factor that could affect production cost such as, labour costs, timescale or tolerances and accuracy required in the components being produced.

Where credit was not given, candidates gave responses relating to material which could not be rewarded with marks because the question asked for two 'other' factors affecting production costs.

Question 6 (a) (i)

6 Fig. 2 shows a disposable cup and plastic drinking straw.

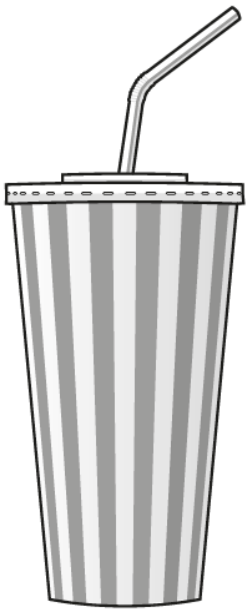


Fig. 2

(a) (i) State **two** environmental pressures that are affected by the products in Fig. 2.

1 .....

2 .....

[2]

On the whole, a large number of candidates were able to gain credit for responses by stating two environmental pressures, however, some candidates gave responses that focused on design considerations that may contribute to environmental pressures rather than the actual environmental pressures themselves.

Where candidates gained credit, they successfully stated environmental pressures such as landfill, resource depletion and land or marine pollution.

Where candidates did not gain credit, responses focused on attributes of the disposable cups and plastic drinking straw such as the materials they are made from and their inability to be recycled. Although these features may contribute to environmental pressures, they are not explicitly an environmental pressure as required by the question.

Question 6 (a) (ii)

(ii) Suggest **two** design changes that could be made to reduce the effect of the disposable cup and plastic drinking straw on the environment.

1 .....

.....

2 .....

.....

[2]

On the whole candidates were able to provide valid responses to this question. The vast majority of candidates were able to suggest two design changes that would reduce the effect on the environment of the disposable cup and plastic drinking straw. Where candidates gained credit, responses suggested design changes such as, making the straw out of paper and making the cup reusable.

Where candidates did not gain full credit, responses either repeated themselves or only one response was given.

Question 6 (a) (iii)

(iii) Give **two** performance requirements that the disposable cup and plastic drinking straw must still meet following the design changes.

1 .....

.....

2 .....

.....

[2]

Candidate responses to this question were generally positive, with the vast majority able to gain at least partial credit. Where candidates gained credit, they provided valid performance requirements such as, the ability of the straw to remain rigid when liquid passed through it and ensuring the cup could still hold a set amount of liquid.

Where candidates did not gain credit, responses focused on the environmental impact as per the requirements of the previous part of this question. For example, candidates stated that's the plastic drinking straw and disposable up should be recyclable.

Question 6 (b)

(b) Explain why disposable cups and plastic drinking straws contribute to environmental pressures.

.....

.....

.....

.....

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

Candidate responses to this question were overwhelmingly positive. Almost all candidates were able to gain at least partial credit by demonstrating an understanding of why disposable cups and plastic drinking stores contribute to environmental pressures.

Where candidates gained credit, responses could explain how disposable cups and plastic drinking straws cannot be recycled and therefore end up in landfill or in the oceans polluting the environment and damaging wildlife or natural habitats. In addition, candidates could also explain how the production of plastic products requires the extraction and processing of crude oil resulting in further damage to the environment and an increase in emissions as the plastic products are manufactured or disposed of at the end of their life.

In the few examples where credit was not given, candidates did not explain their answers, gave vague responses or gave no response at all. Overall, this question was answered extremely well by the vast majority of candidates.

Exemplar 5

Plastic straws mostly don't get recycled and end up in landfill, and eventually in oceans. They can then harm wildlife and destroy habitats. They are also made from fossil fuels which are non renewable and eventually will run out. Disposable cups are only designed to be used once and thrown away, which uses an excessive amount of material. These cups can also end up in oceans and harm animals. **[4]**

Exemplar 5 provides a detailed explanation about why disposable cups and plastic drinking straws contribute to environmental pressures. The candidate has used multiple examples to support their answer ranging from the consequences of incorrect disposal to the extraction of the raw fossil fuel. The response gained maximum credit.

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