

## **CAMBRIDGE NATIONALS**

*Examiners' report*

# **ENGINEERING DESIGN**



**J831, J841**

## **R105 Summer 2019 series**

Version 1

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## 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. 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, mark scheme and specification can be downloaded from the OCR website.

## 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.

This was the tenth series of the R105: *Assessing client briefs, specifications and user requirements* examination paper. In recent series, 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.

### Question 1 (a)

1 Fig. 1 shows an example of a smart watch.



Fig. 1

(a) Shown below are five requirements that inform the purpose of the product.

Join each of these requirements with the correct product feature.

One has been done for you.

Purpose of the product	Suggested product feature
Be a wearable message receiver	Digital clock
Act as a fitness monitor	Heart rate sensor
Be an accurate time piece	NFC chip
Be a personal navigation assistant	Cellular data
Process contactless payments	GPS technology

[4]

This question required candidates to join product requirements that inform the purpose of a product to suggested product features in relation to a proposed design of 'smart watch'.

On the whole candidates were able to join the appropriate product purpose to the suggested features with the vast majority of candidates gaining maximum marks.

Where candidates did not gain maximum marks, they generally mixed up two of the options or missed one of the answers out.

Centres are reminded to encourage candidates to draw neat connecting lines and consider their response before drawing on the paper to make sure their answers are clearly defined.

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

### Question 1 (b)

(b) State **three** pieces of information that designers could gather to help define the purpose of a product.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

A large majority of candidates were able to gain some credit from this question by highlighting examples such as target market or market research.

Where candidates did not gain full credit, they gave responses that were relevant to later stages of the design cycle or were not focused on defining the purpose.

In addition, where candidates lost marks, many gave responses that were repeats of a single category, for example multiple methods of research.

### Question 1 (c)

(c) Explain why it is important for designers to define the purpose of a product before commencing the design.

.....

.....

.....

.....

.....

.....

.....

[3]

A large number of candidates were able to gain some credit with this question, with the vast majority understanding that by defining the purpose, designers are able to effectively produce a product that is fit for purpose, meets the needs of the target market and therefore does not waste time and money due to required redesign or, not meeting the expectations of the client.

Where candidates did not gain credit, responses referred to issues that may occur with manufacturing later in the design stage but that were not a direct link to the product purpose. In other cases, responses were vague, lacked clarity and did not demonstrate understanding of the importance of defining a products purpose.

### Question 2 (a) (i)

2 Fig. 2 shows a travel case.



Fig. 2

(a) State how each of the following limitations and constraints have impacted on the design of the travel case.

(i) Weight

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

The vast majority of candidates were able to gain credit for their responses to part (i), demonstrating understanding that the case needs to be as lightweight as possible so the user can maximise the amount of luggage they can carry when travelling.

In some cases where candidates gained maximum credit, they were able to state how key design decisions such as material or the geometry of the front of the case assisted rigidity and allowed for weight to be minimised.

Where candidates did not gain credit, the responses were too vague or were not exemplified to demonstrate understanding.

### Question 2 (a) (ii)

(ii) Size

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

Overall with part (ii), a large majority of candidates were able to gain credit, understanding how the size of the case can affect its ability to be stored for transportation. In addition, candidates understood the balance between maximising storage capacity and ensuring the case was still a suitable size to move around.

Where candidates did not gain credit, the responses were vague or were not exemplified to demonstrate understanding.

### Question 2 (a) (iii)

(iii) Ergonomics

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

A large number of candidates clearly understood the application of ergonomics in design and were subsequently able to highlight key features of the case that had been specifically designed to improve its ergonomics. For example, where credit was given, candidates understood how the handle had been positioned or formed to make sure it could be moved comfortably by the user and how this, in conjunction, with the wheels, optimised the cases ability to be transported effectively.

Where credit was not given, candidates generally confused the term 'ergonomics' with something else, for example, stating points related to 'aesthetics'.

### Question 2 (b)

(b) Give **one** way the designer could change the 'aesthetics' of the travel case.

..... [1]

The vast majority of candidates were able to gain credit by identifying an aesthetic change to the case. For example, a large number of candidates identified how the colour or material could be changed.

Where credit was not given, candidates generally highlighted a change to the case that was not linked to the aesthetics, for example an ergonomic change.

Overall, this question generated positive responses from candidates.



### Question 2 (c)

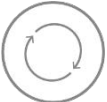

(c) Explain how the designer has considered the working environment in the design of the travel case.

.....  
.....  
.....  
.....  
.....  
.....

[3]

A large number of candidates were able to gain credit here as they could identify features of the case that were added as a result of the cases working environment. For example, candidates could highlight how the case has been created from a durable, rigid, impact resistant material to protect belongings during transport.

Where credit was not given, candidates did not fully demonstrate understanding of ‘working environment’. For example, some candidates focused on the environmental impact of the case and gave responses related to sustainability or recycling. In other examples, candidates focused on the suitability of the case for a professional business environment.

	<b>AfL</b>	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.
	<b>Misconception</b>	Some candidates confused the term ‘working environment’ with environmental issues. The working environment focuses on where the product will be used not issues associated with the environment such as recycling or pollution

#### Exemplar 1

The designer has added wheels so that the case is easy to pull around by the user. It also has a handle which slides away when not in use for better storage, and the case is made of strong plastic. So it can take the weight of other cases on top of and being pushed about.

The exemplar provided shows a well-structured explanation of how the designer has considered the working environment. The candidate has selected multiple features of the product that have been designed in direct response to the case’s working environment.

This response gained maximum credit.

### Question 3 (a)

3 Product safety is a critical consideration for designers when developing new products.

(a) Draw **two** symbols from the list below that could be included on a product.

- British Toy and Hobby Association Lion Mark
- Age restriction logo
- CE mark
- Highly Flammable

<b>Symbol 1</b>	
<b>Symbol 2</b>	

[2]

The quality of drawings varied greatly but a large number of candidates were able to draw, reasonably accurately, two symbols from the list.

Where candidates did not gain credit their representations of the symbols were not accurate enough or in some cases, candidates drew symbols not in the list, for example, the British Standard Kitemark.

### Question 3 (b)

(b) Give **two** reasons why product safety is an important consideration for designers.

1 .....

.....

2 .....

.....

**[2]**

This question generated strong responses from candidates with a large number being able to gain maximum credit for the question.

Candidates clearly understood how product safety helps secure a company's reputation and avoids companies facing financial penalties or losing sales due to products that are not safe to use by the consumer.

In cases where candidates did not gain maximum credit, responses were vague and did not identify a specific consequence of product safety.

### Question 3 (c)

(c)\* Discuss the difference between market pull and technological push.

.....

.....

.....

.....

.....

.....

**[6]**

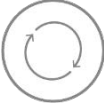
Candidates were required to show understanding of the difference between market pull and technological push through a discussion that assesses their quality of written communication.

Candidate responses varied in quality, but overall, candidates were able to demonstrate some understanding of the difference between market pull and technological push.

Able candidates developed a discussion that clearly defined the differences between the two, supported by good examples of products and a company's approach to each. Candidates could explain both market pull and technological push and were able to compare them to each other.

Where candidates did not gain higher levels of credit in their responses, they focused on one area and did not differentiate between the two. In some cases, candidates gave positive responses to market pull or technological push but did not produce the same quality for both elements of the response.

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.

	<b>AfL</b>	<p>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.</p> <p>Candidates should be taught the difference between market pull and technological push.</p> <ul style="list-style-type: none"> <li>• Market pull is the production of a product based on an identified market demand.</li> <li>• Technological push is the development of new products that incorporate new technologies that are 'pushed' to customers, creating new markets that may not have existed before.</li> </ul>
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### Exemplar 2

wanted it. Technology push however is designing / creating a product the market didn't know they wanted for example, facial ~~very~~ recognition on phones because the market didn't think about it but wanted it when it was created.

The exemplar provides an extract of a coherent, well-structured written response, supported with a valid example. This element of the answer focuses on technology push.

The full response gained credit at Level 3.

### Question 4 (a)

4 The table below contains various points that would be included in a design specification.

(a) Complete the table by adding **four** other points that could be included in a design specification.

1	Aesthetics
2	Ergonomics
3	
4	Limitations and constraints, size, weight, functional limitations
5	
6	Product safety
7	
8	Maintenance
9	
10	British Standards

[4]

Most candidates were able to gain at least partial credit in the question by providing valid points that would be included in a design specification.

Where candidates did not gain some or all of the credit, points were given that were not relevant to a design specification as set out in the R105 specification. In some cases, candidates also repeated answers that were already listed in the table and therefore credit could not be given.

### Question 4 (b)

(b) Explain why a designer must define a design specification before manufacturing a design.

.....

.....

.....

..... [3]

A large number of candidates were able to gain some credit for this question by identifying how a design specification gives a clear set of guidelines for designers and manufacturers to follow while developing a new product, which in turn, results in a product that meets the needs of the client and the customers' expectations.

Where candidates did not gain credit, their responses were vague and did not demonstrate a solid understanding of why a design specification is required before manufacture takes place.

### Question 4 (c)


(c) State **three** areas that would be considered during a Life Cycle Analysis (LCA).

- 1 .....
- 2 .....
- 3 .....

[3]

The majority of candidates were able to gain at least partial credit from their responses demonstrating an understanding of the LCA process from raw material extraction, manufacture, energy use during its life and finally, product disposal / end of life.

Where candidates did not gain credit, responses were occasionally focused on the 'design cycle' rather than product life cycle. This resulted in responses related to activities undertaken during the development of a new product rather than related to the stages of the life cycle.

	<b>Misconception</b>	In some cases candidates focused on the product life cycle from a marketing perspective. Candidates and centres are reminded that this is not the focus of the product life cycle within the specification and subsequently cannot be given credit in responses.
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### Exemplar 3

- 1. Extraction of <sup>raw</sup> materials
- 2. transportation of materials
- 3. end of life consideration - what happens to the product / materials

[3]

Exemplar 3 provides three valid examples that would be directly considered during a Life Cycle Analysis (LCA). The three stages provided by the candidate demonstrate a sound understanding of product life cycle.

This response gained maximum credit.

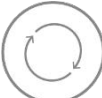
### Question 5 (a) (i)

5 Process planning is an important part of the development of new products.

(a) (i) State which phase of the design cycle includes process planning.

..... [1]

Candidates were generally able to state a phase of the cycle but a large majority were not able to correctly state the 'identify' phase.

	<b>AfL</b>	Centres are reminded to make sure that they spend time ensuring candidates cannot only state the phases of the design cycle but also understand the activities and processes that take place within each phase.
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### Question 5 (a) (ii)

(ii) Give **two** reasons why designers would carry out process planning during this stage of the design cycle.

1 .....

.....

2 .....

..... [2]

On the whole, the vast majority of candidates were able to gain at least partial credit by demonstrating an understanding of how carrying out process planning early in the design cycle allows designers to gain a better idea of the manufacturing process, timescale and cost of the project overall.

Where candidates did not gain credit, responses provided were vague, and did not give specific reasons why process planning is carried out in the early stages of the design cycle.

### Question 5 (b) (i)

(b) The situation and context are important factors when developing a design brief.

State the meaning of the following terms when considering the development of a design brief.

(i) Situation

.....

..... [2]

Responses to both parts of this question varied in quality and in a large number of cases candidates confused the two terms, giving the opposite response to each answer.

Where candidates did gain credit for part (i), 'situation', they were able to state how the situation referred to where the product was going to be used and by whom.

### Question 5 (b) (ii)

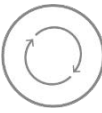
(ii) Context

.....

..... [2]

Again, responses varied but where candidates did gain credit if they understood that the 'context' of a design brief refers to the problem and the background information that led to the brief being developed.

It was clear that in both parts of question 5(b) a large number of candidates did not fully understand the terms or the difference between them.

	<p><b>AfL</b></p>	<p>Centres are reminded to make sure that candidates fully understand key terms and that the specification is covered in its entirety to make sure candidates have the best possible chance of maximising credit within their responses.</p> <p>In the case of question 5b(i) and 5b(ii) candidates occasionally used the opposite response, confusing situation and context. Centres are advised that the 'situation' refers to where the product will be used and by whom. 'Context' is the background information that led to the design being required such as the problem that occurred that the product will help to solve.</p>
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### Question 5 (c)

(c) Describe how designers may use inspirational and iconic products to inform the development of a new design.

.....

.....

.....

..... [3]

The vast majority of candidates were able to gain at least partial credit from their responses.

A large number of candidates were able to demonstrate an understanding of how inspirational and iconic products have been previously successful; are examples of good design, and; by taking inspiration from them, may result in a product that is instantly recognisable by customers, resulting in similar market success.

Where candidates did not gain full credit their responses were vague or focused on copying a design without linking this to inspirational or iconic products.



### Question 6 (a)

6 Fig. 3 shows a vacuum cleaner.

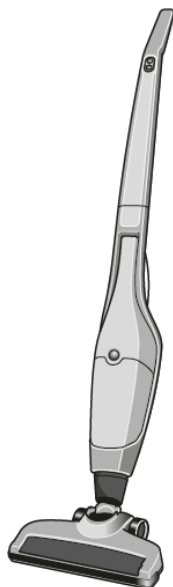


Fig. 3

(a) State **three** ways that the vacuum cleaner in Fig. 3 could be designed for maintenance.

- 1 .....
- 2 .....
- 3 .....

[3]

Where candidates gained credit, they understood the principles of design for maintenance and were able to provide responses that focused on the use of standard components/tools, product disassembly and non-permanent fixing methods.

Where candidates did not gain credit, their responses generally focused on how a vacuum cleaner could be used to carry out maintenance e.g. cleaning, but not how the vacuum cleaner itself had been designed so maintenance could be carried out on the product.

### Question 6 (b)

(b) Explain how maintenance can contribute to sustainable design.

.....

.....

.....

..... [3]

A large number of candidates were able to gain at least partial credit for their responses.

Able candidates were able to state how regular product maintenance can extend a products life. Therefore, avoiding the product being thrown away and ending up in landfill, while also reducing the amount of raw materials being extracted and processed to make replacement vacuum cleaners.

Where candidates did not gain credit, responses focused on sustainability more generally and were not directly linked to maintenance.

#### Exemplar 4

Maintenance reduces the likelihood of products ending up in landfill which is wasteful of resources so less is wasted with maintenance. This means less raw material needs to be extracted from the earth to continue making <sup>more products</sup> [3]

Maintenance reduces energy that's needed to extract more materials so reduces carbon footprint

Exemplar 4 provides a detailed explanation of how maintenance can contribute to sustainable design.

The candidate has provided a high-level response that demonstrates an understanding of multiple factors of sustainable design and how maintenance can contribute to these.

This response gained maximum credit.

### Question 6 (c) (i)

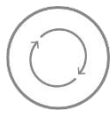
(c) New production processes can impact on the design of new products.

(i) Give **one** example of a new production process.

..... [1]

On the whole, candidates were able to state a production process but a large majority did not state a 'new' process instead giving well established examples such as injection moulding.

Where candidates did gain credit they were able to list an appropriate process such as additive manufacturing technologies / 3D printing or industrial automation. In a small number of cases, candidates gave example products or design considerations that had no link to a production process.

	<b>AfL</b>	Centres are advised to make sure candidates develop knowledge of 'new' manufacturing processes. A large number of candidates could provide responses about well-established manufacturing processes such as machining or injection moulding, but did only a small number of candidates were able to talk about new manufacturing processes such as automation or additive manufacturing.
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### Question 6 (c) (ii)

(ii) Give **three** advantages of the new production process in your example given to part (i).

- 1 .....
- .....
- 2 .....
- .....
- 3 .....
- .....

[3]

Where candidates have given a production process in part (i) that was not a 'new' process the error was carried forward so candidates could still gain credit for part (ii).

Where candidates gained maximum credit they were able to list three relevant advantages of the production process such as the ability create complex geometry through additive manufacturing or increased accuracy and reduction of errors in industrial automation.

Where candidates did not gain credit, responses had no direct link to a production process or responses were vague.

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