

CAMBRIDGE NATIONALS

Examiners' report

ENGINEERING DESIGN



J831, J841

R105 Summer 2018 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 can be downloaded from OCR.

Paper R105 series overview

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

This was the eighth series of the R105: *Assessing client briefs, specifications and user requirements* examination paper. Due to the number of series now that have now been undertaken, it is clear that centres are preparing candidates for the paper more effectively resulting in candidates being able to access the paper and gain marks on the vast majority of topics covered in the specification. This paper particularly highlighted some of the more engineering elements of 'design' that successfully allowed the paper to discriminate across the ability ranges.

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 specimen papers and, with growing availability, 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. This was particularly evident in this paper in the areas of design that were more focused on the engineering elements of the specification.

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 computer mouse.

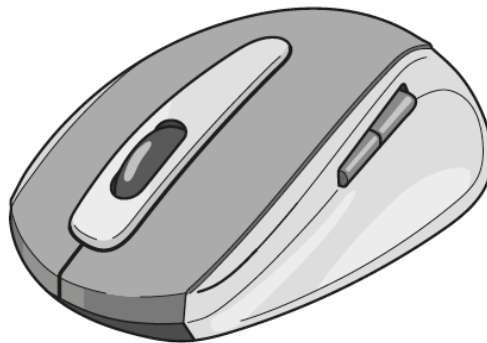


Fig. 1

(a) Shown below are four user needs.

Join each user need with the correct suggested product feature.

One has been done for you.

User needs	Suggested product feature
Must fit comfortably in the hand	Optical sensor
Should be aesthetically pleasing	Bluetooth connectivity
Must be wireless	Ergonomically designed
Must work on multiple surfaces	High-gloss finish

[3]

The question required candidates to join the user need with the correct product feature. On the whole, candidates were able to make the correct links and achieve maximum marks on the question. Where candidates were not credited with the maximum mark, they had missed a connecting line therefore only gaining two of the three possible marks; or in some cases, candidates had drawn multiple lines making it difficult to identify which 'User need' was linked to which 'Product feature.' Overall, the question provided a positive opening to the paper.

Question 1 (b)

- (b) Give **two** ways, other than the mouse must fit comfortably in the hand, that the designer has considered ergonomics in the design of the computer mouse.

1

.....

2

.....

[2]

This question required candidates to give additional ways that the design of the mouse shown in Fig.1 had considered ergonomics in its design. Most candidates were able to identify at least one additional feature of the mouse that had been designed with consideration of ergonomics such as the position and placement of the buttons and scroll wheel. Other candidates who did not gain credit, gave responses that were either too vague, and not specifically related to an ergonomic feature or the responses repeated the stem of the question regarding 'comfort' and therefore did not qualify for credit as 'additional' ergonomic design elements.

Question 1 (c)

- (c) Give **two** anthropometric measurements that would be important when designing the computer mouse.

1

.....

2

.....

[2]

This question required candidates to consider the 'anthropometric' measurements that have informed the 'ergonomic' design decisions the candidates had highlighted in question 1b. Where candidates gained maximum credit, they were able to give specific anthropometric measurements that would be critical to a designer's decision making when defining the dimensions of the mouse. These answers included responses such as the 'length of fingers' or the 'distance/span between fingers.' Other candidates gave responses that did not demonstrate an understanding of the differences between 'ergonomics' and 'anthropometrics'. Therefore, these responses did not gain credit because the responses were not specific to the anthropometric measurements required.

Question 2 (a) (i)

- 2 (a) Fig. 2 shows two mobile phones. Phone **A** is a modern 'smart' phone. Phone **B** is an earlier model phone.

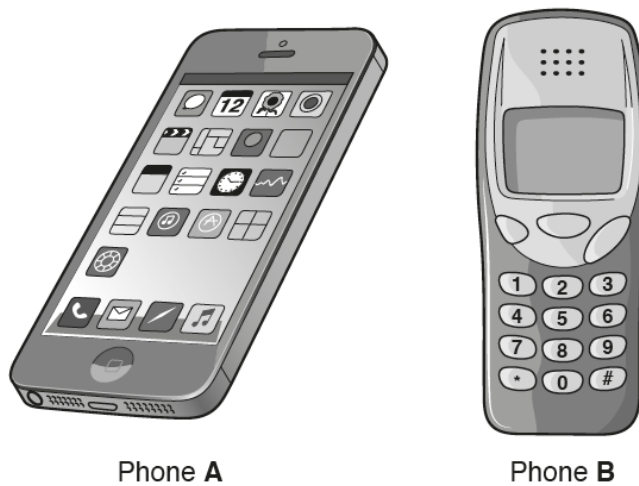


Fig. 2

- (i) State **two** ways in which cultural and fashion trends have influenced the design of modern 'smart' phones like Phone A.

1

2

[2]

Overall, this question was well answered by the vast majority of candidates. Most candidates were able to provide responses worthy of credit that highlighted some of the primary cultural or fashion trends that have influenced the design of modern smart phones, such as; the accessibility of social media; the internet and the associated requirement of bigger screens; and the development of touch screen technology. Where other candidates did not gain credit, responses referred to vague aesthetic features of the phone or generic cultural or fashion developments that were not directly linked to the design and development of the phone.

Question 2 (a) (ii)

- (ii) Market research has suggested that there is a customer demand for the earlier model phone **B**.
Explain why some customers may want the earlier design of phone.

.....

 [2]

Responses to this answer were generally answered well with large numbers of candidates able to access some, if not all of the marks. Those candidates that gained a maximum credit were able to provide responses that showed understanding of how Phone B may be more accessible for people with less mobility due to the physical buttons on the device. They were also able to highlight that the phone had less features and was therefore simple to operate for the elderly perhaps. Candidates also gained credit by referencing the fact that the phone was probably more durable than a modern smartphone due to the more modern phone being made with a glass screen.

Exemplar 1, below, illustrates a good written explanation that clearly defines two points worthy of credit to gain maximum marks.

Exemplar 1

.....The earlier phone has less accessories and is.....
 more simplistic than the modern ~~the~~ phone which.....
 could appeal to an older generation..... [2]

Question 2 (b)

- (b) Give **one** example of a legislative design requirement and describe why it is important when designing new products.

Example

Description

.....

[3]

This question required candidates to give an example of a legislative design requirement followed by a description of why the legislation was important when designing and developing new products. Some candidates were able to gain credit in the description part of the question, even though they may not have given an appropriate legislative design requirement as an example. Very few candidates were able to gain credit for a specific example. Centres are advised to ensure that the specification is covered in depth. For this example, candidates should be aware of specific legislation that affects design requirements. Centres should use available resources and past mark schemes from previous papers to support candidates' development of knowledge.

Question 3 (a)

3 Manufacturers consider ease of manufacture when designing new products or components.

(a) The table below shows a range of products and the manufacturing processes used.

Complete the table by adding the most relevant statement given below about ease of manufacture.



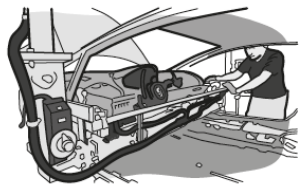
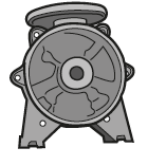

Allows the use of pre-manufactured and standard components

Allows for cost effective metal component production

Can create one-off components rapidly

Creates high volume, complex plastic parts in a single process

One has been done for you.

	Example product	Manufacturing process	Ease of manufacture
1	 Plastic school chair	Injection moulding	
2	 CNC machined bearing housing	Machining	Creates very accurate parts with a high surface finish
3	 Automotive assembly line	Final assembly on production line	
4	 Cast pump housing	Sand casting	
5	 Prototype prosthetic hand	3D printing	

[4]

This question required candidates to match a manufacturing process to statements related to how the process assists the ease of manufacture. Overall, candidates were able to achieve credit on this question with many gaining maximum marks. In some cases, candidates did not match the correct process to the appropriate statement which demonstrated a limited understanding of particular manufacturing processes. Other candidates, who did not gain any credit, either did not make one successful match or, more commonly, had not read the question in detail and instead of populating the table with the statements provided, wrote their own responses which gained no credit. Candidates are advised to read the question in detail to ensure they have the appropriate information and guidance to provide a response worthy of credit.

Question 3 (b)

- (b) Name **one** manufacturing process, other than those given in part (a), that could be used to produce a product.

.....
 [1]

Candidates were on the whole able to gain credit by naming one other manufacturing process. Where credit could not be given candidates gave answers that repeated responses from part (a) or gave secondary processes such as permanent joining methods, like welding. As per the previous question candidates are reminded to read the question in detail and respond accordingly to maximise credit.

Question 3 (c)

- (c) State **two** ways that products can be designed to allow for maintenance.

1

 2
 [2]

This question required candidates to state two ways that products can be designed to allow for maintenance. Most candidates were able to gain some credit by giving responses related to the use of standard parts, design for disassembly or creating accessibility to critical parts. Where credit could not be awarded, candidate responses were not specific enough.

Question 3 (d)

- (d) Explain why the manufacturing process may have an impact on production cost.

.....

 [3]

Candidate responses to this question varied. Able candidates gave responses that demonstrated a solid understanding of how initial set-up costs, tooling, labour and energy costs have a direct impact on the cost of production. Many candidates gave responses related to material cost however this did not gain credit as this is an associated cost but not directly linked to the process which is clearly stipulated in the question. In addition, some candidates referred to the time that a process may take and inferred that the longer the process takes the more expensive the cost. This is not always strictly true and therefore could not be given credit unless the answer was further justified with a particular example or comparison.

Question 4 (a)

4 (a) Complete the statement below.

There are two main reasons why designers may see an opportunity to develop new products.

Firstly, a gap in the market may be identified based on consumer need. This is called

.....

Secondly, designers may have access to new materials or manufacturing methods that allow new and improved products to be created. This is called

.....

[2]

Question 4a required candidates to complete two statements. It was clear that candidates were either very confident in their responses and understood the statements therefore providing the correct response or did not achieve any credit for the question.

Exemplar 2, below, shows the only two possible responses; 'Market Pull' and 'Technological Push.' No other responses were awarded credit for this question.

Exemplar 2

Firstly, a gap in the market may be identified based on consumer need. This is called

Market pull ✓

Secondly, designers may have access to new materials or manufacturing methods that allow new and improved products to be created. This is called

Technology push ✓

[2]

Question 4 (b)

(b) Name the **four** phases of the design cycle in the correct order.

1

2

3

4

[4]

This question required candidates to list the four phases of the design cycle. Responses to this question had to match the design cycle detailed in the specification and also be in the correct order. The order of the phases is clearly important in the process of developing a new product so candidates could only gain credit if they put the appropriate phase in its corresponding place in the order.

Exemplar 3, on the next page, shows a response that gained maximum credit.

Exemplar 3

- 1 ~~Identify~~ Identify ✓
- 2 Design ✓
- 3 Determine ✓
- 4 Validate ✓
- [4]**

Question 4 (c) (i)

- (c) (i) Give **one** method a designer could use to carry out market research.

.....
[1]

Overall this question was answered well with most candidates able to gain the credit available. Answers had to be specific and give an actual method of research. Where credit was not given, candidates gave responses that were not specific such as 'primary' or 'secondary' research which did not show a clear understanding of methods that can be used to gather information on the market or users.

Question 4 (c) (ii)

- (ii) Explain why market research is an important part of developing a new product.

.....
[3]

This question requires candidates to explain why market research is an important part of developing a new product. Candidates on the whole were able to gain credit for their responses due to their understanding of how; market research can ensure a suitable target market is available; the product contains features the market wants; and the design is developed to match the customer requirements. Where candidates did not gain maximum credit, responses did not contain multiple points, points were not developed, or extended explanations were not given. Candidates and centres are reminded that they should ensure responses are written in line with the action verb from the question e.g. 'Explain', to ensure they are able to access appropriate credit from their responses.

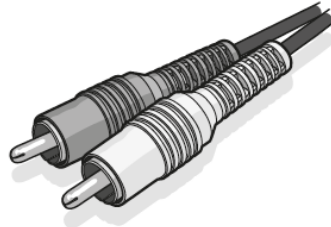
Question 5 (a) (i)

5 Error proofing is an important part of developing a new product.

(a) Below are two products.

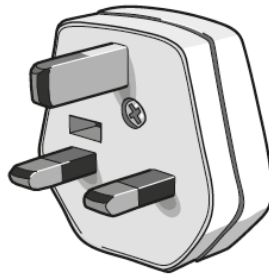
State how the operation of each product has been error proofed.

(i) Audio cable



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

This question required candidates to state how the audio cable had been error proofed. Those candidates that were able to gain credit correctly identified that the cable had colour coded adaptors that showed the user which way to plug the cable in, to ensure the correct function. This is the primary error proofing decision made by the designer and therefore the main response that candidates needed to provide to gain credit. Some candidates focused on elements of the design related to safety such as insulated cables or reinforced elements of the head of the cable to minimise breakage. Although some of these points were valid observations they were not the main design decision related to error proofing and therefore could not gain credit. Centres are reminded to ensure candidates understand that error proofing is related to minimising misuse during operation and not always safety or durability of a product.

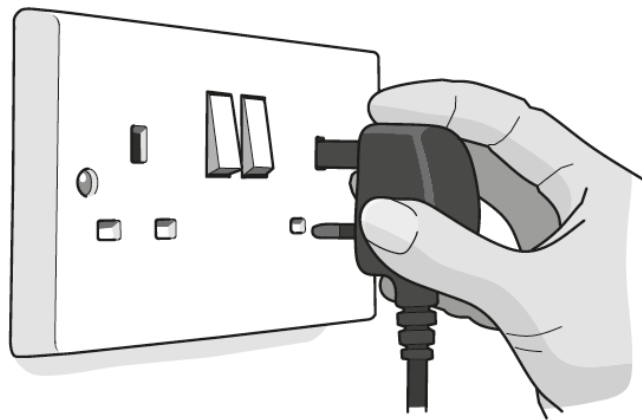
Question 5 (a) (ii)**(ii)** 13 amp plug

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

Similarly to part (a)(i) of this question, those candidates that gained credit stated that the arrangement of the three pin plug stopped the plug being inserted into a socket in the incorrect orientation. Many candidates again focused on the safety elements of the design such as an insulated casing, but these responses are not directly linked to minimising error in operation. In these cases, credit was given to responses that highlight the use of the fuse within the plug which acts a fail-safe in certain situations. As in the previous question, centres are reminded to ensure candidates understand that error proofing is related to minimising misuse during operation and not always safety of a product.

Question 5 (b)

- (b) A company who make plug-in electric heaters have received customer feedback that some users of their heaters find standard plugs difficult to take out of the plug socket when the heater is not being used.



Suggest **two** ways in which the design of the plug could be changed to make it easier to take out of the plug socket.

1

.....

2

.....

[2]

This question required candidates to consider how the design of a plug may be modified to make it easier for people to remove from the socket. Candidates had to provide two possible responses. On the whole, most candidates were able to provide at least one response that was worthy of credit. These responses stated a possible change in material for something that provided additional grip or, the addition of ergonomic features to the side of the mouse such as 'grooves' that allowed for more effective removal of the plug. Where responses did not gain credit, they made suggestions for modifications that would not be feasible such as reducing the size of the pins that are inserted into the socket. Three pin plugs are designed and manufactured to a set dimension to fit standard sockets so this was not a valid response.

Question 5 (c)

- (c) Give **one** type of regulation that a product must meet before being sold.

.....

..... [1]

This question required candidates to give one type of regulation that products must meet before being sold. Candidates that gained credit here were able to state a specific regulation or gave answers that related to safety which were credited. Where credit was not awarded candidates were giving vague answers or stating areas of consideration not related to regulation. Candidates and centres are reminded that the specification details regulations and safeguards that should guide teaching to specific examples.

Question 5 (d)

(d) Give **two** types of safeguard that may protect a product.

1

.....

2

.....

[2]

This question required candidates to give two possible safeguards that protect products. Where credit was awarded for this question, candidates successfully listed safeguards related to intellectual property such as, patents, trademarks or copyright. Where candidates did not gain credit, the responses related to safety systems included within products. Candidates and centres are reminded that the specification details regulations and safeguards that should guide teaching to specific examples and an understanding of the differences between regulations and safeguards. In addition, the specification refers to safeguards that protect product intellectual property not safety features included in the design to stop malfunction of human error.

Question 5 (e)

(e) Explain why it is important for products to meet regulations.

.....

.....

.....

.....

.....

.....

..... [3]

This question required candidates to detail why it is important for products to meet regulations. Most candidates were able to gain some credit here through responses that highlighted how regulations ensure that consumers are protected and products are likely to not cause harm to the user. Some responses were able to develop this further by explaining how regulations also ensure a certain standard of quality and allow for the product to be subsequently sold. Where candidates did not gain maximum credit, responses were not developed or multiple points were not made and therefore a credit for a maximum mark 'explanation' could not be given. Candidates and centres are reminded to action the command verb of the question, in this case 'Explain', to ensure they provide the capability to access maximum credit.

Question 6 (a)

6 Fig. 3 shows a pulley and shaft assembly used on an electric motor.

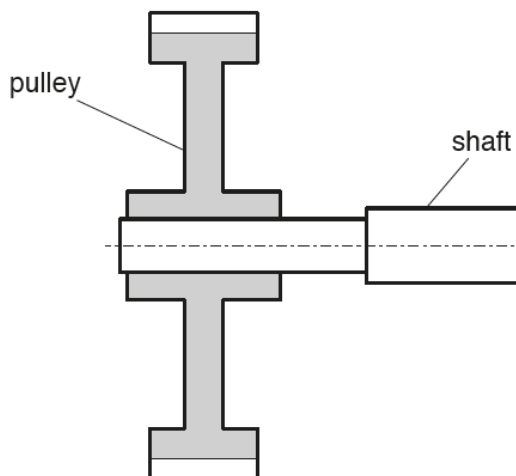


Fig. 3

(a) State **one** critical dimension of the pulley and shaft assembly that would require specific tolerances.

.....
 [1]

This question required candidates to state one critical dimension from a diagram of a pulley and shaft that would require a specific tolerance. Generally, candidates were able to provide a valid response, but a large number of candidates were not specific enough in their answers. Those candidates that gained credit on this question were able to state specific dimension such as critical internal or external diameters. Those candidates that did not gain credit gave responses that related to certain areas of the shaft or pulley but were not specific and did not use dimensioning terminology e.g. diameter.

Question 6 (b)

(b) Give **two** reasons why tolerances allow for the successful operation of the pulley and shaft assembly.

1

.....

2

..... [2]

On the whole candidates were able to gain some credit on this question. Most candidates were able to give reasons why tolerances allow for successful operation of the assembly. In many cases, despite gaining credit, some responses could have been applicable to any use of tolerance in an engineering assembly. Many of these points gained credit but it is important for candidates to aim to give specific responses to particular scenarios and not rely on generic answers. Overall, candidates have demonstrated a relevant understanding of the use of tolerances and how they assist the successful operation of assemblies.

Question 6 (c)

(c) Give **one** reason why tolerances help to manage production costs.

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

Candidate responses to this question varied. Those candidates that were able to gain credit were able to discuss how tolerances give components an acceptable variance that can help manage the precision required during production. Therefore, avoiding components being scrapped and allowing more freedom of accuracy during manufacture which reduces production cost. Where candidates did not gain credit on this question, they generally focused on 'saving material.' Which, is only a minor advantage unless they further developed this answer to quantify that the material saving was due to a lack of scrapped parts.

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