CAMBRIDGE NATIONALS

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Examiners' report

ENGINEERING DESIGN

J831, J841

R105 Summer 2022 series

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 responses 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 and the mark scheme can be downloaded from OCR.

Advance Information for Summer 2022 assessments

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our website.

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 and complete R105 and R106, or work towards the Certificate and complete R105, R106, R107 and R108. Unit R105 is the only externally examined unit with the other units being centre assessed. The synoptic exam paper followed the same format as all previous series, having six questions with a total of 10 marks each, covering all three learning outcomes in R105. There were 26 parts within the six questions for June 2022 with no optional question parts. To do well on this examination paper, candidates needed to have gained and demonstrated knowledge and understanding of the Identify phase of the design cycle, manufacturing considerations and processes involved in designing engineered products, product safety, and scale of production, e.g., just-in-time production. Candidates that performed well demonstrated knowledge of wider influences on designs including composite materials, signs and symbols for materials, products and safety, sustainable design, and energy sources. Candidates should be able to apply this knowledge in a written description, explanation and discussion of design and manufacturing processes and considerations, and how scale of production is used in the manufacture of designs.

Most candidates attempted all the questions on the paper, with relatively few questions omitted as exceptions, which is not uncommon among some lower achieving candidates. It is not uncommon for candidates at the lower end of the performance range to omit the 6-mark question designed to assess quality of written communication and specification content knowledge and understanding. Question 4(c)* in this series was no exception. Teachers should encourage all candidates to make some attempt at all question parts, not least the QWC question worth 6 out of a total of 60 marks 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, which included Questions 4(b) and 4(c)*. Candidate are reminded, as in previous series, to read the questions thoroughly. Some misread Question 3(b) and named the two symbols shown, instead of naming two different symbols to those shown. There was evidence of some misunderstanding of the key terms used within the questions, possibly due to candidates having not considered the correct context of the question, and or due to gaps in knowledge.

Candidate understanding, and use of some key terms/meanings and the ability to use these in the correct context, impacted on performance across many question parts including 1(b)(i), 1(b)(ii), 4(b), and 6(c). These include 'process', i.e., processing raw materials, 'scale of production', 'manufacturing processes', and 'sustainability'. Candidates have used terms associated with scale of production types in place of examples of manufacturing processes such as moulding, forming, etc.

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 • understood types of information used to inform the design brief, why and how market research is carried out and used • were able to demonstrate knowledge of presenting designs, including engineering drawings • understood types of scale of production, and how these can influence manufacturing costs and efficiency, and manufacturing processes • demonstrated knowledge of sustainable design and the impact on designs • demonstrated knowledge of product safety, and safety symbols used on materials and products.	• showed limited understanding of scale of production within Questions 4(b) and 4(c)* • gave simplistic responses such as 'saves time', 'cheap', 'has a handle' and 'effective' without some justification to show understanding • did not make links between factors that affect the budget for developing a new product • did not correctly give responses related to the terms used within the specification. These include 'sustainability' and 'manufacturing processes' • did not always read the question carefully to avoid repeating given information as their responses.

Question 1 (a) (i)

1 Composite materials are becoming more common in manufacturing.

(a) The table below shows a range of materials.

(i) Complete the table by placing a tick (✓) in the correct column to indicate if the material is a composite, or is **not** a composite.

One of each has been done for you.

	Material name	Composite	Not a composite
1	Aluminium		✓
2	Carbon Fibre		
3	Concrete	✓	
4	Copper		
5	Fibre glass		
6	MDF		

[4]

For this question part, most candidates were able to correctly indicate at least two or more materials as being a composite or not a composite.

Question 1 (a) (ii)

(ii) State what is meant by the term 'composite'.

.....

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

Many candidates were able to state that a composite is made up of two or more other materials but relatively y few stated that combining these materials produces improved/enhanced properties. Of those candidates that did, only some gave an example, such as strength.

Question 1 (b) (i) and (ii)

(b) **(i)** Some materials are more difficult to process than others. Give **two** reasons why this could affect the budget.

1 .....

2 .....

[2]

(ii) Name **two** other factors that can affect the overall budget for developing a new product.

1 .....

2 .....

[2]

Candidates attaining higher overall marks were able to give two correct responses for this part. Candidate responses needed to be more specific and related to the cost of materials, instead of what may cause the cost of material processing to affect the budget.

Question 2 (a)

2 Designers use a range of information alongside market research to inform the development of design briefs.

(a) Give **two** pieces of information other than market research that may inform a design brief.

1 .....

2 .....

[2]

Generally, this question was less well answered across the ability range. The question did not elicit the expected responses from many candidates, but instead candidates gave the responses expected for Question 2(c). Relatively few candidates achieved 2 marks. Many candidates incorrectly gave answers stating types of market research, rather than information that informs a design brief.

Question 2 (b) (i) and (ii)

(b) Complete the **two** terms below to describe market forces for new products.

(i) ..... pull **[1]**

(ii) Technological ..... **[1]**

Most candidates correctly completed the two terms in Question 2(b)(i) and Question 2(b)(ii). More candidates correctly answered Question 2(b)(i) 'market' than part 2(b)(ii) 'push'.

Question 2 (c)

(c) State **two** types of market research that can be used to identify design needs.

1 .....

2 .....

[2]

This question part was well answered by most candidates. Candidates were able to accurately recall and state research types. The mark scheme included a wide range of research types that could be given.

Question 2 (d)

(d) Explain why designers undertake market research.

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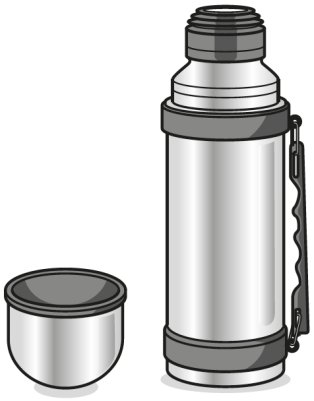
..... **[4]**

Many candidates were able to correctly explain why designers undertake market research, giving appropriate examples, to achieve 3 or 4 marks. Overall, this question part was well answered by candidates.

Question 3 (a)

3 **Fig. 1** shows a thermos flask.

Fig. 1



(a) State **two** ways the design of the flask has considered product safety.

1 .....

2 .....

[2]

Most candidates were able to give at least one correct way the design of the flask has considered product safety. Some responses could not be given the mark, for example 'it has a handle' or responses unrelated to the purpose of the product.

Exemplar 1

1 Roondel the lid so it's not pointy.....

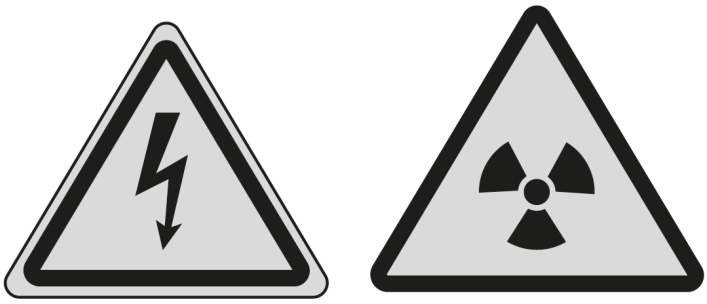
2 ~~sharpe edges are made of plastic.~~ well insulated so doesn't get hot on the outside. **[2]**

In this example, the first response given is unrelated to the intended purpose of the product. The second response is appropriate to demonstrate knowledge of product safety related to the given product. One mark total was given.

Question 3 (b)

Fig. 2 shows two safety symbols used on some electrical products.

Fig. 2



(b) Name **two** other safety symbols displayed on products.

1 .....

2 .....

[2]

Product safety is a part of the specification where candidates generally were able to clearly demonstrate knowledge and understanding. Most candidates across the mark bands achieved 2 marks for this part. However, some candidates did not read the question properly and named the safety symbols shown. It is important that candidates carefully read the question fully, and use images where provided, to check their understanding of what they are being asked for.

Question 3 (c)

(c) Describe how designers can ensure the product is safe to use.

.....

.....

.....

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

This question part was generally well answered with a high proportion of candidates at all levels achieving the 2 marks available. Candidates were able to give relevant examples of testing although were not necessarily required to do so to achieve the marks. However, many candidates also stated that providing instructions and using safety signs can make sure the product is safe to use. Marks were not given for instructions and safety signs/warnings.

Question 3 (d)

(d) Explain why product safety can contribute to the success of a new product.

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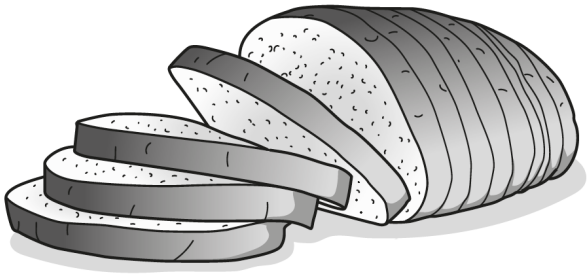
..... **[4]**

This question part was very well answered with a high proportion of candidates at all levels achieving at least 2 marks, and more often 3 or more marks. Candidates were able to give good and valid explanations with justification why product safety can contribute to success of a new product.

Question 4 (a) (i)

4 **Fig. 3** shows bread that has been batch produced.

Fig. 3



(a) **(i)** Give **one** advantage of batch production.

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

This question part was generally well answered. However, candidates should be specific in their response, avoiding simplistic and vague responses such as 'efficient', 'cheaper', or 'low cost' without some justification or comparison made with other scales of production, to adequately demonstrate understanding worthy of the mark.

Question 4 (a) (ii)

(ii) Give **one** disadvantage of batch production.

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

Candidates found giving a disadvantage of batch production more challenging than giving an advantage. The mark scheme allowed a wide range of possible responses where it was anticipated these would be accessible by candidates.

Question 4 (b)

(b) State why the scale of production can influence the manufacturing process used.

.....

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

This question part was generally less well answered across the ability range. Relatively few candidates were given 2 marks. Answers were often limited to stating that mass production would be used for producing many products, and responses including the misconception that mass/high-volume production results in low quality. The correct responses should contain a reference to manufacturing processes used to achieve the scale of production, such as use of machinery, tools or processes used within the given scale, i.e. injection moulding, or stamping used in high volume/mass produced engineered products, templates, moulds and use of CNC to provide repeatability, automated assembly, etc.

Assessment for learning

OCR has produced a Scheme of work and Delivery guide to support centres with suggested teaching content, where centres can find delivery/activities that include manufacturing considerations: manufacturing processes.

Question 4 (c)

(c)* Discuss how just-in-time production is used in manufacturing.

.....

.....

.....

.....

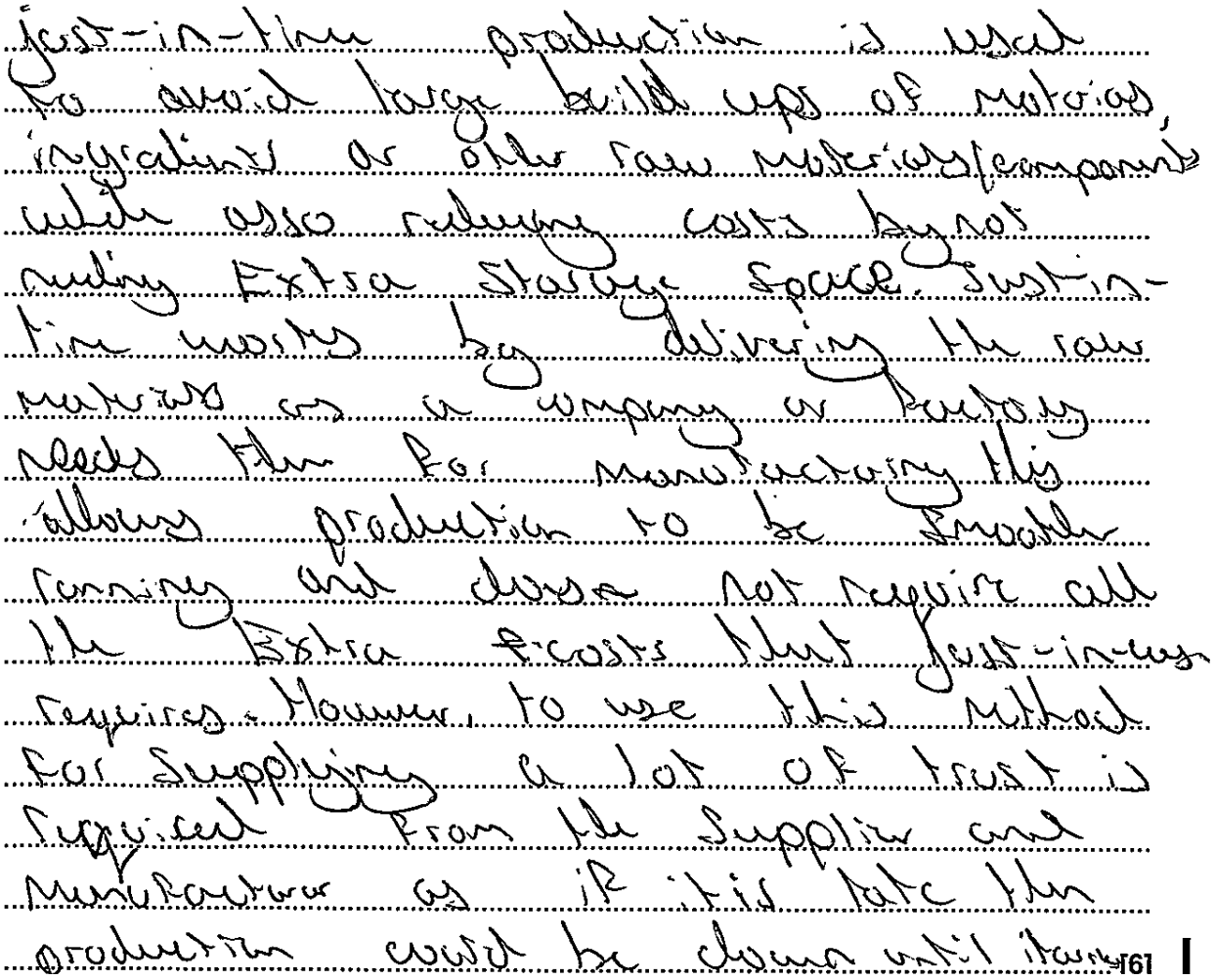
.....

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

The quality of written communication is assessed with this question. Due to what could be a gap in knowledge in this part of the specification, responses given for part 4(c) were often presented less well than expected. Knowledge and understanding of just-in-time (JIT) was lacking by most candidates. JIT was added to Learning Objective 2 within the specification for first teach from September 2020, and centres are reminded to cover this within their teaching.

Marks were, in the main, given to references to storage considerations, and some candidates were able to include references to the use of JIT in automotive manufacturing. Relatively few candidates achieved marks at Level 3. Candidates that were given 3 or more marks gave examples of unplanned delayed delivery/access to parts as a risk impact of JIT production. For many candidates, marks were not given as candidates had not written appropriate responses. Candidates should ideally structure their response to this type of question as a discussion, in a way that demonstrates knowledge of the JIT, e.g. how and why use JIT, and show understanding through developing statements of knowledge such as through discussion of the advantages and disadvantages, or the impact of JIT strategy, e.g. what leads to successful/unsuccessful use of JIT.

Exemplar 2



This is an example of a Level 2 response. The candidate demonstrates knowledge and understanding, stating some the benefits of JIT, and has structured the response leading to a discussion. Some technical terms are given and used appropriately. Further discussion points with development, and an example product/industry could have taken the response to Level 3.

Question 5 (a)

5 Designers create a range of ideas when developing designs for new products.

(a) Give **two** reasons why designers develop a range of design ideas.

1 .....

2 .....

[2]

A high proportion of candidates gave two correct reasons why designers develop a range of design ideas. The responses given were generally very close to those given within the mark scheme.

Question 5 (b)

(b) State **one** format, other than engineering drawings, designers can use to present their final designs.

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

A high proportion of candidates stated a correct format other than engineering drawings. A good range of responses were given including the use of prototypes, PowerPoint presentations, 3d printed models and CAD models. Some candidates named CAD software products, which was acceptable to demonstrate knowledge.

Question 5 (c)

(c) State **three** features of an engineering drawing that assist with manufacture.

1 .....

2 .....

3 .....

[3]

Many candidates did not respond as expected; many candidates gave simplistic responses such as 'size' but lacked knowledge and understanding of engineering drawings features. Other candidates needed to have read the question properly. Developing of planning and engineering drawings was added to the specification within Learning Objective 1 for first teach in 2020. 'Tolerances' (one of several possible correct responses) is included within Learning Objective 2 and is not part of the recently added content; tolerances has been within the specification since the introduction of the qualification. The gap of understanding engineering drawings led to fewer candidates achieving more than 2 marks on Question 5 part (d).

Question 5 (d)

(d) Explain how the features of engineering drawings improve the quality of a final product.

.....

.....

.....

.....

.....

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

Many candidates gave incorrect responses stating the drawing could be used to improve the quality of the final product by showing where changes needed to be made. Candidates need to read questions carefully to make sure they fully understand what is being asked of them. The question makes clear that the drawing is of a final product (for manufacture). Candidates achieving 3 or 4 marks will have correctly explained how measurements and tolerances included in engineering drawings are used to improve the quality of the final product, with references to components fitting properly, and will have made the links between tolerances, quality, ease of assembly, and function.

Question 6 (a) (i) and (ii)

6 Renewable energy sources can contribute to sustainable design.

(a) (i) Name **two** renewable energy sources.

1 .....

2 .....

[2]

(ii) Name **two** non-renewable energy sources.

1 .....

2 .....

[2]

Candidates across the ability range performed well on questions related to sustainable design. Most candidates correctly named two renewable energy sources. Marks were given where candidates gave the primary source of energy, e.g., wind, tides, etc. Most candidates were able to name two non-renewable sources in part 6(a)(ii).

Question 6 (b)

(b) Give **two** advantages of using renewable energy sources.

1 .....

2 .....

[2]

Most candidates gave at least one correct response to this part. However, some candidates gave simplistic responses such as 'it's cheaper', 'costs less' and 'sustainable' which were not given marks.

Question 6 (c)

(c) Explain how sustainability considerations can impact on the design of a new product.

.....

.....

.....

.....

.....

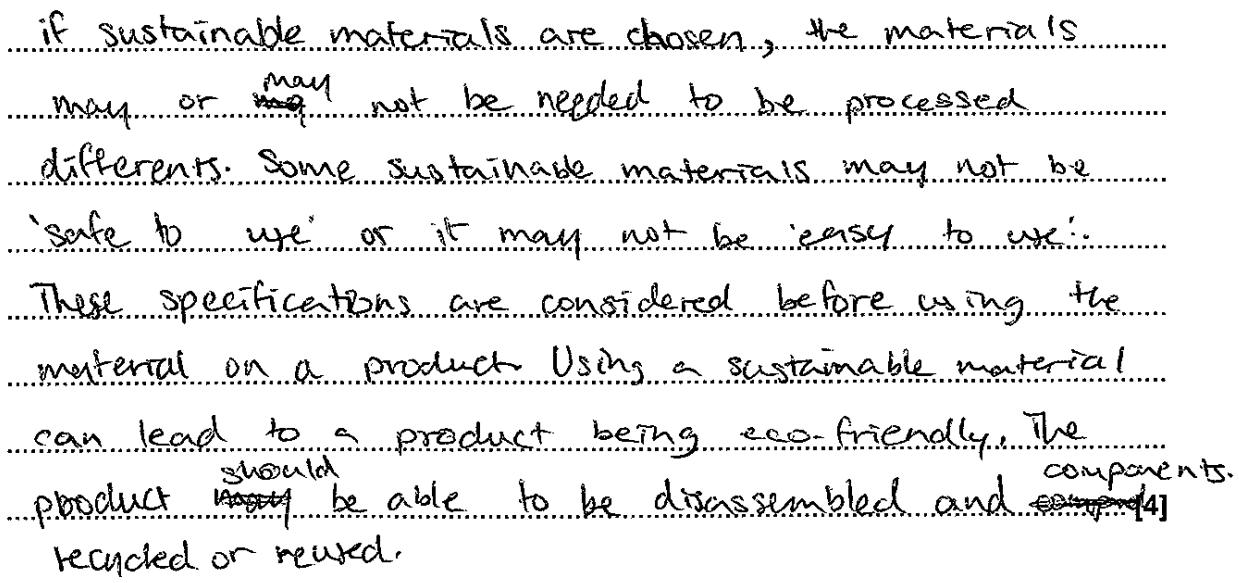
..... **[4]**

Candidate performance for this question part was variable, although overall candidates across the ability range found the question accessible, with relatively few candidates omitting to answer it. Many candidates were able to give good explanations with references to changes in materials impacting on the design aesthetics, using renewable energy sources for the product or for manufacturing, the use of recyclable materials and the use of standard components for disassembly. Candidates achieving 1 or 2 marks only gave responses with too much focus on environmental impact without explaining, or with only limited details of how sustainability considerations impact on the design.

Misconception

Some candidates misunderstand the meaning of the term 'sustainability'. The term is used in R105 in the context of sustainable design, i.e. renewable and non-renewable energy, the 6Rs. However, some candidates in this and previous exam series incorrectly give responses in the context of the longevity of the design, and how long the products can continue to be manufactured due to materials being no longer obtainable.

Exemplar 3



This candidate has covered a range of relevant points demonstrating sound knowledge of how sustainability impacts on design. The candidate could have given an example of a specific sustainable material to be used in the design. For this response, 3 out of 4 marks were given.

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