ENGINEERING DESIGN

INCLUDED ON THE KS4 PERFORMANCE TABLES

*Examiners' report*

**OCR Level 1/Level 2**

**Cambridge National in**

# Engineering Design

**J822**

For first teaching in 2022 | Version 1

**R038 January 2024 series**

**ocr.org.uk/cambridgenationals**

Cambridge Nationals

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Oxford Cambridge and RSA

# 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 and the mark scheme can be downloaded from Teach Cambridge.

# R038 series overview

This is the first full series for this newly reformed Level 1/Level 2 Cambridge National in Engineering Design, and we were pleased with the responses that we received from the cohort for R038. The candidates appeared to have had a relatively good grounding across this endorsement for the most part.

The report below seeks to give pragmatic advice to centres that will be helpful as they prepare their next cohort for this style of examination.

**Basic concept**

This style of examination has an allowed time of 1 hour 15 minutes.

The total mark for this paper is 70.

The marks for each question are shown in brackets [ ].

The question paper begins with a set of ten multiple choice questions.

The question paper is designed to have a range of questions that carry a marking tariff between 1 and 6 marks.

There is one extended response question, Question 15(c) which is assessed via a level's response.

| Candidates who did well on this paper generally: | Candidates who did less well on this paper generally: |
|---|---|
| • had a broad understanding of engineering design and had a fulsome knowledge of the specification<br>• had a good understanding of engineering drawing conventions and principles and were able to apply these accurately<br>• had a good understanding of sustainability design, and were able to communicate this effectively<br>• were able to give examples to given scenarios and justify their responses<br>• were able to give answers with a justified response to demonstrate knowledge and understanding<br>• were able to identify manufacturing processes. | • did not appear to have a broad knowledge of engineering design or the specification more generally<br>• found engineering drawing conventions challenging<br>• found justification difficult when extending a point they had made<br>• did not have a clear understanding of terms used within manufacturing processes<br>• did not give an example within their answer where required, to access the higher marks<br>• did not always read some questions thoroughly before answering<br>• struggled to identify and explain appropriate manufacturing processes. |

# Section A overview

Generally well answered, with many candidates finding the range of questions accessible.

Some candidates did not attempt some of the questions in this section. Even if a candidate is unsure when attempting multiple choice questions, it is still advisable to have a go.

Candidates who are afforded extra-time or have special consideration sometimes typed out each response in full rather than simply ticking a box. This is obviously time consuming for them and we would urge centres to encourage candidates to make use of the opportunity to access multiple choice questions on the question paper as well as utilising the opportunity to respond via typing their answers for any other questions that they wish. It is perfectly acceptable to use both modes within their response.

## Question 1

**1** Which of these products would typically be mass produced?

**(a)** Bridge ☐

**(b)** Canned food ☐

**(c)** Handmade jewellery ☐

**(d)** Racing car ☐ **[1]**

(b) Canned food is the correct response and was accessible for many candidates.

## Question 2

**2** Which of these views are shown in a third angle orthographic projection drawing?

**(a)** 30° face and side, top ☐

**(b)** Front, right side, top ☐

**(c)** Front, top, left side ☐

**(d)** Top, side, exploded ☐ **[1]**

(b) Front, right side, top is the correct response. Candidates did find this challenging on occasion.

## Question 3

**3** Which of these is an example of 'Refuse' within the 6Rs?

**(a)** Refusing to only buy organic materials ☐

**(b)** Refusing to only use wind energy sources ☐

**(c)** Refusing to use an unsustainable raw material ☐

**(d)** Refusing to use composite materials in a design ☐ **[1]**

(c) Refusing to use an unsustainable raw material is the correct response. Candidates often had a good grasp of the 6Rs and so found the correct response.

## Question 4

**4** Which of these is an example of anthropometric data?

**(a)** A measurement of eye level ☐

**(b)** A measurement of the height of a chair seat ☐

**(c)** The distance of a user's wrist to a keyboard ☐

**(d)** The size of the average computer mouse ☐ **[1]**

(a) A measurement of eye level is the correct response. Some candidates were confused with which responses were related to anthropometric data.

## Question 5

**5** Which of these manufacturing processes involves making three dimensional solid objects in layers from a digital file?

**(a)** 3D printing ☐

**(b)** Shaping ☐

**(c)** Turning ☐

**(d)** Wasting ☐ **[1]**

(a) 3D printing is the correct response, and most candidates were successful.

## Question 6

**6** Which of these materials is most suitable for making a concept model that does **not** need to be physically tested?

**(a)** Aluminium ☐

**(b)** Carbon fibre ☐

**(c)** Card ☐

**(d)** Epoxy resin ☐ **[1]**

(c) Card is the correct response, and most candidates were successful.

## Question 7

**7** Which of these is a product criterion included in a design specification?

**(a)** Assembly instructions ☐

**(b)** Cost ☐

**(c)** Labour ☐

**(d)** Production of models ☐ **[1]**

(b) Cost is the correct response, and most candidates were successful.

## Question 8

**8** At which stage of the design process would a freehand sketch be used?

**(a)** To communicate how the design will look in the intended environment ☐

**(b)** To communicate technical features of the design ☐

**(c)** To present final design ideas ☐

**(d)** To present initial concept design ideas ☐ **[1]**

(d) To present initial concept ideas is the correct response, and most candidates were successful.

## Question 9

**9** Which of these statements is a correct description of market pull?

**(a)** Customers demanding a product is removed from the market ☐

**(b)** Customers demanding lower price mobile phones ☐

**(c)** Designers adding a new feature in response to customer feedback ☐

**(d)** Designers building in features that will only work for a limited time ☐ **[1]**

(c) Designers adding a new feature in response to consumer feedback is the correct response and many students were successful.

## Question 10

**10** Which of these manufacturing processes is an example of wasting?

**(a)** Disposal of materials into landfill ☐

**(b)** Not recycling plastic bottles ☐

**(c)** Pouring molten metal into a mould ☐

**(d)** Routing a channel in a piece of wood ☐ **[1]**

(d) Routing a channel in a piece of wood is the correct response. Unfortunately many candidates misunderstood the term 'wasting'.

# Section B overview

This section has a range of questions styles that generally fall into the following categories:

Identify a specific piece of information, image or reason for 1 mark. For these questions, candidates are required to be able to demonstrate their knowledge by identifying or recognising a given item within a diagram / image, or use direct recall to answer a question, for example the definition of a term.

Questions 14(a)(i) and (ii) required candidates to demonstrate knowledge and understanding by interpreting the given drawing and drawing in the space provided using correct drawing conventions.

Describe, Analyse and Discuss questions test candidates' understanding in greater depth than identification or recall style. Understanding will be demonstrated through answering how, why, reasons for, advantages, considerations of something to / in different contexts. For example:

- Describe how something might occur or describe how a particular circumstance will be affected or impacted by a situation for 2-3 marks. Examples are often sought in these questions with a mark being given for an appropriate example.
- Analyse an approach or explain the advantages of a technical scenario for 3-4 marks.
- Discuss: candidates would be expected to approach from more than one point of view. A higher tariff question, with up to 6 marks available and marked via the level of response given within the answer. Candidates should provide more than just a series of statements and be able to expand on these with reasoning, the impact of and or justification. Higher marks are given for responses that include a reasoned discussion / debate with appropriate use of terminology.

## Question 11 (a) (i)

**11** A designer has been given a brief to design a child's toy.

The table below shows a range of product design requirements.

**(a)**
**(i)** Complete **each column** of the table by adding in the missing requirements **under** each heading.

Some requirements have been completed for you.

| Child's toy | | | |
|---|---|---|---|
| **User requirements** | **Product safety requirements** | **Material safety requirements** | **Manufacturing requirements** |
| *Suitable for boys and girls* | | | *Readily available materials* |
| *Educational* | | | *Can be moulded in a range of colours* |
| *Accessible interactive features and functions (buttons/lights)* | *Safe to use in a range of environments* | *Flame resistant* | |

**[5]**

A wide range of responses were offered by candidates from no choking hazards/finger traps through to textures of materials used and scales of production and repeatability. Many candidates gained full marks.

Unfortunately, many candidates replicated the examples that had already been given in the boxes.

## Question 11 (a) (ii)

**(ii)** Identify **one** method of **primary** research that could be used when considering suitable interactive features and functions for the child's toy.

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

Numerous correct responses were offered with interviews, questionnaires and surveys being very popular responses.

A small number of candidates appeared to mix up primary research methods with secondary research methods.

## Question 11 (b)

**(b)** Describe how designers can ensure the child's toy is suitable for its intended customers.

.....

.....

.....

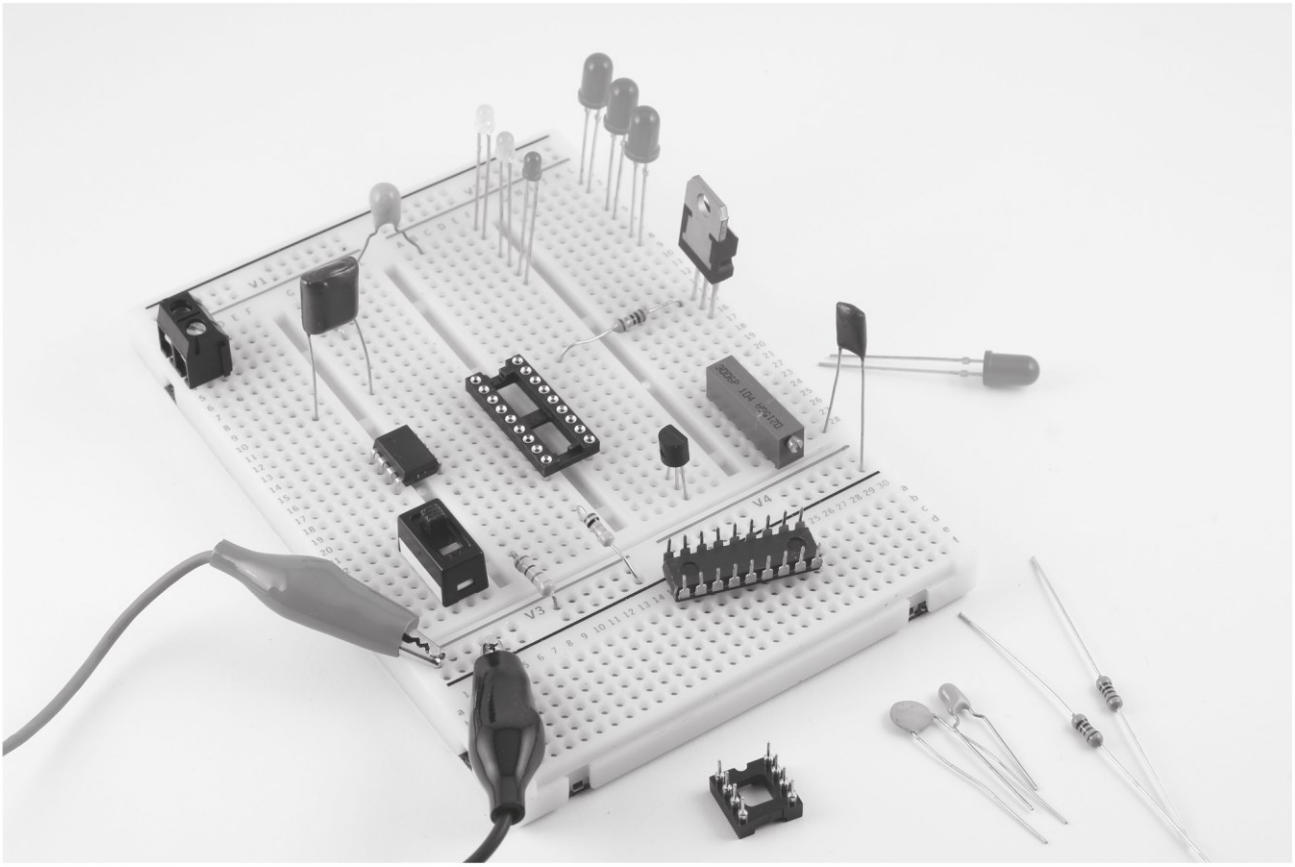
..... **[2]**

Candidates often made two separate points or made a single point with justification with both approaches being accepted. User centred design, user testing, safety features and child friendly features were among a wide range of very perceptive responses.

## Question 11 (c)

**(c)** **Fig. 1** shows a breadboard that is used to experiment with making circuit designs, for example a circuit with lights and switches for modelling purposes.

**Fig. 1**



Identify **two** limitations of using breadboarding compared to on-screen simulation.

1 .....

.....

2 .....

.....

**[2]**

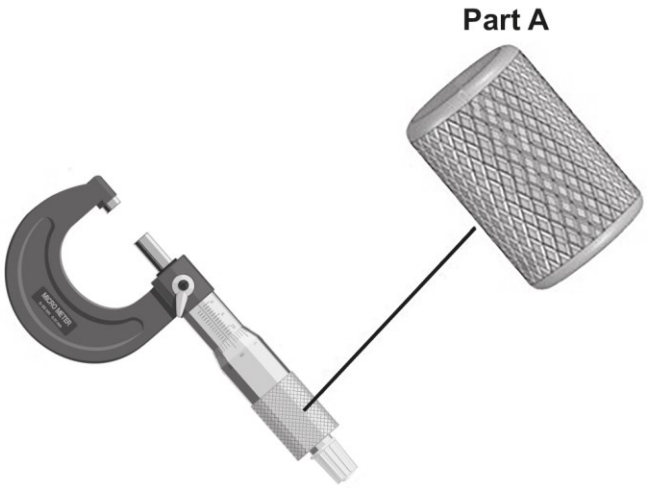
Some candidates found this question a challenge.

Correct responses highlighted that it cannot be shared or saved easily, unlike on-screen simulation and you physically need to have a range of components to make full use of breadboarding. Marks were also given where candidates gave responses that were correct advantages of using on-screen simulation.

## Question 12 (a) (i)

**12** **Fig. 2** shows a CAD model of a tool. Part of the tool is enlarged and labelled **Part A**.

**Fig. 2**




**(a)**
**(i)** Identify the mechanical feature used for the finish on **Part A**.

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

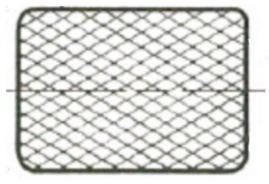
Knurl or diamond knurl were the only accepted correct responses. While a number of candidates answered correctly, many did not know the technical name.

## Question 12 (a) (ii)

**(ii)** Complete the drawing below to add how the mechanical feature you have identified would be represented on an engineering drawing.

**[1]**

While not explicitly the case, the majority of candidates that answered knurl/diamond knurl above were able to demonstrate how it would be represented on an engineering drawing. The centre line was often not shown but that did not impact on the number of correct outcomes.



## Question 12 (a) (iii)

**(iii)** Describe how ergonomic considerations have influenced the use of this mechanical feature on the tool.

.....

.....

.....

.....

.....

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

Candidates were able to explain that the knurl afforded the user more grip and in some cases they were able to justify this further with benefits to the user such as comfort and ease of use.

### Exemplar 1

The ergonomic consideration of placing ~~the~~ knurl on the handle makes it so that the mechanical gesture on this tool can be tightened significantly easier compared to if there was no finish. This makes it easier for people to grip onto the tool, no matter their strength or hand size. **[3]**

In Exemplar 1 the candidate clearly highlights that the mechanical feature allows the product to be easier to use than without a finish being added. They then continue to explain that it also makes it easier to grip and negates the need for a particular level of strength/hand size of the user.

## Question 12 (a) (iv)

**(iv)** Other than ergonomics, identify **one** reason why a surface finish would be applied to a tool.

.....

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

Enhancement of aesthetics to look better quality was easily the most regular response from candidates. Prevention of corrosion, increasing durability and making cleaning easier were also written.

## Question 12 (b)

**(b)** Orthographic drawings often include lines that show hidden details.

Identify **one** example of an engineering drawing feature where hidden details would be used.

.....

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

Candidates found this question a challenge, which was somewhat surprising given the importance of engineering drawing in this specification. Threaded holes, holes and recesses were occasionally given as correct responses.

## Question 12 (c)

**(c)** Describe, using an example, how the design of a handheld tool can be affected by its intended purpose.

.....

.....

.....

.....

.....

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

Candidates found this to be one of the most challenging questions on the paper. Candidates that gave a specific example of a handheld tool did well and were able to then link particular properties such as hardness or the length of a handle or shaft for leverage with some justifications.

## Question 13 (a) (i)

**13** A new design for an office chair is being developed.

**(a)**
**(i)** Identify **two** methods of **secondary** research that could be used to influence the design work.

1 .....

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

Numerous correct answers were offered with internet research and books being very popular responses.

Some candidates appeared to mix up secondary research methods with primary research methods.

**Primary and secondary sources**

Candidates should have a clear understanding of both primary and secondary sources of information and within this be able to explain with examples how both are used to aid the design process. There was often some confusion between the two and particularly when examples were sought.

## Question 13 (a) (ii)

**(ii)** Describe how secondary research sources could be used to provide ideas for the aesthetics of the design of the office chair.

.....

.....

.....

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

Candidates were able to describe a secondary research source but often found it difficult to link the source and how it helped to inform ideas for the design of the office chair. Where candidates did link the secondary source and for example designs that are popular or in demand due to colour, shape or style then they gained full marks.

## Question 13 (a) (iii)

**(iii)** Describe, using an example, how the design of the office chair could be affected by the choice of manufacturing process.

.....

.....

.....

.....

.....

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

Candidates often misunderstood what was being asked with responses focusing on scales of production, which was unfortunately incorrect. Topic area 2, (2.2) within the specification lists the broad types of manufacturing processes candidates should understand and be able to give examples of. There were some very good examples given with injection moulding and forming in one piece so reducing the number of processes required. Examples were not always given which limited the marks these candidates could be given.

## Question 13 (b)

**(b)** Explain the advantages of using user testing to evaluate the design of the office chair.

.....

.....

.....

.....

.....

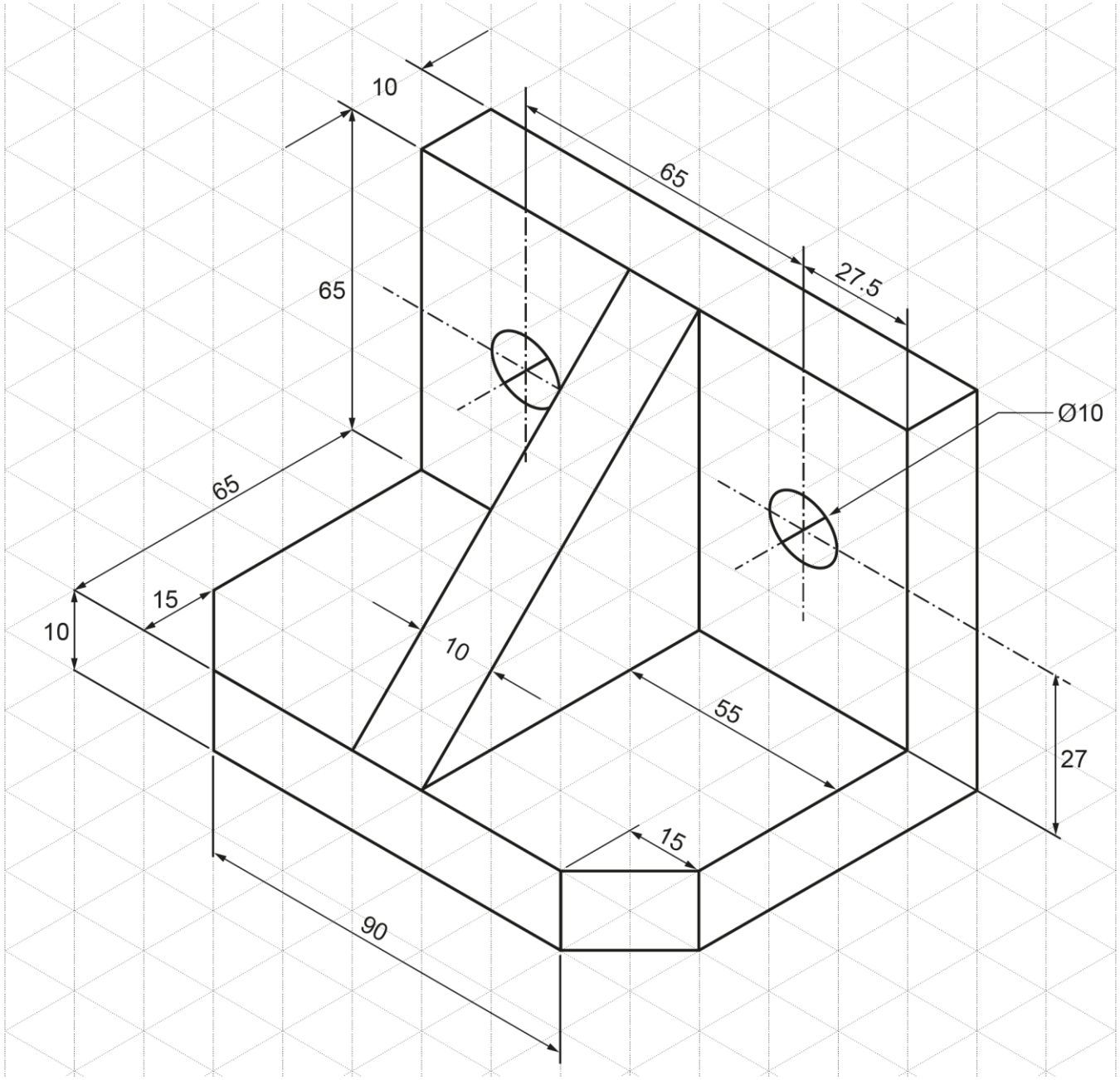
..... **[3]**

A very well attempted question with the vast majority of candidates gaining marks on this question and often 2 or full marks. Candidates were able to clearly articulate and justify that gaining firsthand feedback from a specified audience allowed for modifications to be made that should increase sales and marketability.

## Question 14 (a) (i)

**14** **Fig. 3** shows an isometric drawing of a bracket.

**Fig. 3**




(not to scale)

**(a)**

**(i)** In the space provided, draw the **shape** of the **top view** in third angle orthographic projection.

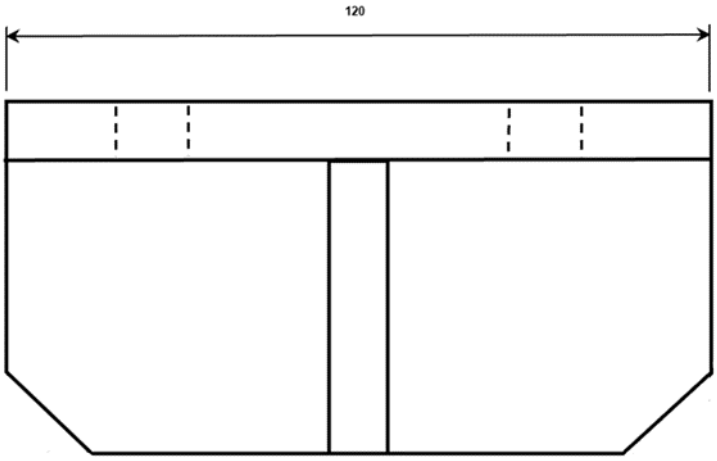
**[3]**

Candidates were often able to draw the top view in third angle orthographic projection. Marks were given for the orthographic drawing with correct orientation and the holes. The holes were not always shown.

## Question 14 (a) (ii)

**(ii)** The overall bracket length is 120 mm.

**Add** this dimension to your drawing in **part (a)(i)** using the correct engineering drawing conventions. **[4]**




Engineering drawing conventions are of particular importance within the R038/01 specification. Marks were given in the following way:

Any four aspects from:

The horizontal dimension line will be of the overall length of the bracket (above or below the drawing) (1)

The dimension measurement (120) should be central and above the dimension line (1)

Leader lines should not touch the component (1)

The arrow heads should have solid points (1)

Arrows should touch the inside of the leader lines (1)

Although candidates were not required to draw to scale, care should be taken to apply drawing conventions neatly and carefully to meet the mark points within the mark scheme.

## Question 14 (a) (iii)

**(iii)** Other than dimensions and hidden details, identify **two** pieces of information that would be shown on an orthographic drawing.

1 .....

2 .....

**[2]**

Candidates were able to identify a wide range of information with materials, scale and title block being popular responses. Unfortunately, some candidates appeared to misinterpret dimensions giving measurements as their response, which is a repeat of the question.

## Question 14 (b)

**(b)** Identify the abbreviation used for 'across flats' in engineering drawings.

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

A number of candidates correctly identified AF as the abbreviation.

## Question 15 (a)

**15**

**(a)** Sustainable design is an important consideration when designing electrical products.

Complete the table by identifying **two** ways electrical products can be designed to become more sustainable.

Some example answers have been provided for you.

| **Design ideas for sustainability** |
|---|
| |
| |
| *Automatically switched off if left on for a long time* |
| *Designed to reduce energy usage* |

**[2]**

Candidates were able to complete the table offering a wide range of different ways that products can be designed to be more sustainable. Being rechargeable, using LEDs, and sustainable materials were among many sensible correct responses.

## Question 15 (b)

**(b)** Describe how legislation can influence the design of electrical products used in the home.

.....

.....

.....

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

Candidates found this question particularly challenging with 2 marks rarely being given. However a number of candidates did correctly describe safety as a reason that legislation influenced the design of electrical products.

## Question 15 (c)

**(c)** An engineering company is proposing to import materials from overseas to use as part of a sustainable design strategy.

Discuss the impact on the **environment** of importing materials from overseas/other countries.

.....

.....

.....

.....

.....

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

Many candidates discussed the impacts of the transportation choices when importing materials from overseas/other countries and then explained how boats, planes and trucks contributed to the overall carbon footprint and harm to the environment.

There were also some very good discussions around noise and water pollution when using the air/sea.

Some candidates also discussed how there might be a benefit to bringing sustainable materials into the UK.

This is a Levels of Response question with the majority of candidates either achieving Level 1 or Level 2. Some candidates achieved Level 3, demonstrating a thorough understanding of the sustainability considerations when importing materials, via a reasoned discussion.

## Exemplar 2

Importing metals from overseas ~~or~~ requires for them to be transported using lorries, trains, planes and/or ships. All of these transportation methods require the use of fossil fuels for the petrol. Fossil fuels are not renewable and the use and mining of them contribute to the greenhouse gases which have an affect on climate change & global warming, which affects the environment negatively.

The exemplar is a top of Level 2 response attaining 4 out of the 6 marks available. The response demonstrates an understanding of the modes of transportation and explains how fossil fuels are used. It then explains that they are not renewable and mining them furthers climate change.

## Question 16 (a)

**16** A range of factors can influence product design.

**(a)** Describe how British and international standards impact on product design.

.....

.....

.....

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

Candidates were able to describe the basics of British and international standards and within their impact on product design correctly identified how they help improve safety, comply with minimum requirements and that they can be used across Europe.

## Question 16 (b)

**(b)** Reverse engineering is one method of analysing existing products.

Identify **two** ways disassembly of competitors' products can inform manufacturing methods for a new product.

1 .....

.....

2 .....

.....

**[2]**

A very well attempted question with candidates correctly identifying a number of ways that disassembly can inform manufacturing methods of new products. Assessing materials, components, manufacturing methods and assembly were all seen regularly.

## Question 16 (c)

**(c)** Describe, using an example, how labour costs could affect product assembly methods.

.....

.....

.....

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

Candidates found it very challenging to describe how labour costs affect assembly methods, with very few giving an example.

## Question 16 (d)

**(d)** OCR Car Wheels is a company that manufactures alloy wheels.

Used car wheels are bought in and re-manufactured to make them look like new. Wheels that cannot be re-manufactured are disposed of and some may go to landfill.

Analyse how this approach meets the key principles of the circular economy.

.....

.....

.....

.....

.....

.....

.....

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

Candidates were able to analyse a basic approach to a circular economy, often stating one or more key principles. Very few candidates could identify that the approach is not fully sustainable, does not fully meet the principles of a circular economy, as some materials are wasted and sent to landfill.

## Exemplar 3

This approach allows for used products that are not recyclable to be able to be reused, making them sustainable. However the wheels that wouldn't be able to be re-manufactured would still lead to this approach not being fully sustainable, so those wheels could be repurposed for something else e.g. safety barriers.

Exemplar 3 not only clearly highlights how circular economy allows used products to be recycled but also explains why the approach is not fully sustainable and explains how it could be further improved.

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Question 12(a), image of micrometer, © Heavypong / GettyImages

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