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 Summer 2024 series

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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 OCR.

R038 series overview

This is only the second series for this newly reformed Level 1/Level 2 Cambridge National in Engineering Design, but candidates responded strongly with the responses that we received from the large cohort for R038. The candidates appeared to have had a relatively good grounding across this course 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 – features of the paper reminder

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, 14(c), and this is assessed via a level response approach.

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 extensive knowledge of the specification • had a good understanding of engineering drawing conventions and principles and were able to apply these accurately • had a good understanding of a range of modelling techniques, and the benefits to the user and manufacturer • were able to give examples to given scenarios and justify their responses • were able to give answers with a justified response to demonstrate knowledge and understanding • were able to identify manufacturing processes • had some understanding of material forms and methods of shaping materials • were able to demonstrate knowledge of product criteria and why it is important to prepare a design specification • had a working knowledge of Flow diagrams /Block diagrams • analysed given information, such as charts, graphs and tables • understood key terms including 'Labour costs', 'Capital costs' and 'Finishing process'.	• did not appear to have a broad knowledge of engineering design or the specification more generally • found engineering drawing conventions challenging • found justification difficult when extending a point they have made • did not have a clear understanding of terms used within manufacturing processes • did not give an example within their answer where required, to access the higher marks • did not always read some questions thoroughly before answering • struggled to identify and explain appropriate manufacturing processes • did not demonstrate knowledge of abbreviations used and standard drawing conventions used.

Section A overview

Generally, Section A was well answered, with many candidates finding the range of questions accessible with positive outcomes.

Some candidates didn't 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 given extra-time or have special consideration sometimes typed out each answer 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 using 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 answer.

Question 1

1 Which type of engineering drawing would be included with the product for after-sales support?

(a) Exploded view ☐

(b) Isometric ☐

(c) Oblique ☐

(d) Orthographic drawing ☐ **[1]**

Although this question targets Option A as its answer, on balance the marking team considered there could be scenarios where each of the other options could be considered correct. Therefore, to be fair to all, we accepted any of the four options on this question.

Question 2

2 Which word describes what the product is made from in ACCESS FM?

(a) Mass ☐

(b) Material ☐

(c) Measurement ☐

(d) Model ☐ **[1]**

(a) Material is the correct answer. Candidates did find this challenging on occasion.

Question 3

3 Which of these is a type of modelling used for electronic circuit design?

(a) Breadboarding ☐

(b) Block modelling ☐

(c) Card modelling ☐

(d) Sketching ☐ **[1]**

(a) Breadboarding is the correct answer and was accessible for many candidates.

Question 4

4 Which angle is used to represent three sides of an object in an isometric drawing?

(a) 30° ☐

(b) 45° ☐

(c) 90° ☐

(d) 180° ☐ **[1]**

(a) 30° is the correct answer and was accessible for many candidates

Question 5

5 What is **user-centred design**?

(a) A design process where the general public get to test the product ☐

(b) A design process where the designer focuses on the user and their needs ☐

(c) Designing a product that users can recycle easily ☐

(d) Designing a product to ensure most people can use it ☐ **[1]**

(b) A design process where the designer focuses on the user and their needs is the correct answer and was accessible for many candidates.

Question 6

6 Which of these is the **purpose** of an assembly drawing?

(a) To show all the different parts to help identify replacement parts ☐

(b) To show how parts are put together to make a final product ☐

(c) To show how the parts are made ☐

(d) To show the sustainable design features ☐ **[1]**

(b) To show how parts are put together to make a final product is the correct answer. Some candidates were confused and often cited (a) to show all the different parts to help identify replacement parts.

Question 7

7 Which of these is an example of labour costs to a manufacturing business?

(a) Employee wages ☐

(b) Energy used ☐

(c) Machinery and equipment ☐

(d) Rent ☐ **[1]**

(a) Employee wages is the correct answer and was accessible for many candidates, although some candidates did get confused and cited (b) energy used on occasion.

Question 8

8 Which of these is an example of a **finishing process**?

(a) Assembling final parts ☐

(b) Cutting a thread ☐

(c) Packing products for shipment ☐

(d) Chrome plating a door handle ☐ **[1]**

(d) Chrome plating a door handle is the correct answer. Unfortunately, many students did not understand the term 'finishing process' in this context and incorrectly gave either (a) or (c) as their answer. In contrast to this, most candidates were able to correctly identity the finishing process in Question 11(b).

Misconception

Many students did not understand the term 'finishing process' in this context. It is important that students understand the types of manufacturing processes, listed in 2.2 of the specification.

Question 9

9 Which symbol shows the **radius** on an engineering drawing?

(a) ∅ ☐

(b)  ☐

(c) 

☐

(d)  ☐ **[1]**

(c) R20 is the correct answer, which was accessible for the majority of candidates although a number did offer other answers.

Question 10

10 Which of these is an example of **sustainable design**?

(a) Being able to disassemble a product at the end of its life for reusable parts ☐

(b) Being able to use the same design over and over again to produce products ☐

(c) Producing products that appeal to a wide range of users ☐

(d) Producing products using materials from fossil fuels ☐ **[1]**

(a) Being able to disassemble a product at the end of its life for reusable parts is the correct answer. Candidates often had a good grasp of the 6Rs and consequently found the correct answer.

Section B overview

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

Identify or state 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 13(a)(i) and 13(a)(ii) required candidates to demonstrate knowledge and understanding by interpreting the given drawing or information in the space provided using correct drawing conventions or abbreviations.

Explain, 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:

- Explain or 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 awarded for an appropriate example.
- Evaluate questions for 4 marks require candidates to consider benefits and or drawbacks of a given approach to design.
- 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 award for answers that include a reasoned discussion/debate with appropriate use of terminology.

Question 11 (a) (i)

11 Products are made in different scales of production depending on the type of product being made, and the manufacturing methods being used.

(a)
(i) State **one** product that is often produced in batches.

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

Numerous correct answers were offered, with everything from batch loaves through to limited edition cars as popular responses.

Question 11 (a) (ii)

(ii) Manufacturing considerations is one product criteria in a design specification.

State **one other** product criteria in a design specification.

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

Candidates had for the most part understood the acronym ACCESS FM and as such gave a wide variety of responses within this understanding.

Question 11 (b)

(b) Use the terms below to identify the manufacturing process used for each manufactured product in the table.

Not all the terms are used.

One has been completed for you.

~~**Assembly**~~ **Finishing** **Forming** **Joining** **Shaping** **Wasting**

Manufactured product	**Manufacturing process**
Blow moulded bottle	
Riveted toolbox	
Polished aluminium tap	
Circuit board and components	Assembly
Machine turned bolt	

[4]

Candidates were often able to correctly identify 'Finishing' as the manufacturing process for a polished aluminium tap. However, there were very few candidates that correctly identified all four correctly, often transposing Forming and Wasting.

Blow moulded bottle = Forming

Rivetted toolbox = Joining

Machine turned bolt = Wasting

Question 11 (c) (i)

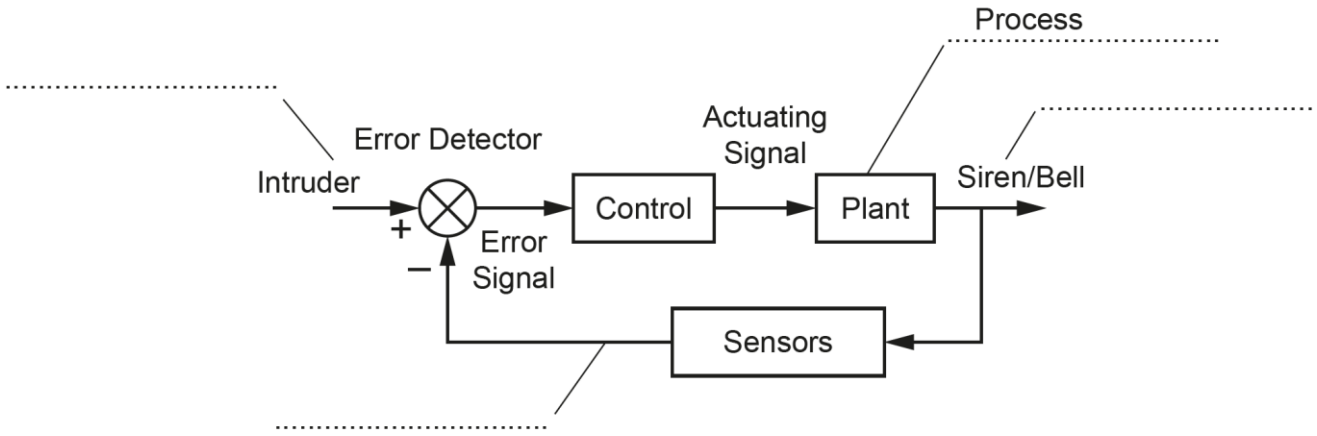
(c)

(i) Complete the block diagram to show how a security system functions.

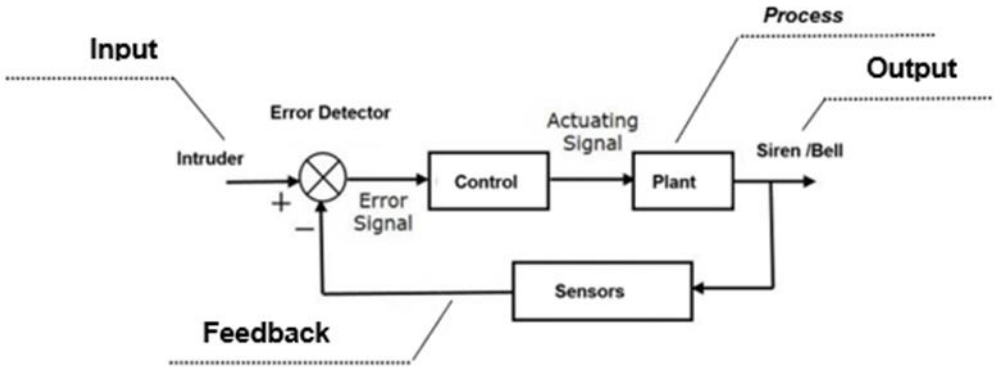
Use **three** words from the list below.

One has been completed for you.

Block **Feedback** **Input** **Output** ~~**Process**~~



[3]

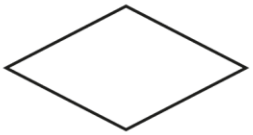


Candidates were often able to correctly identify Input, Feedback and Output correctly. Occasionally Feedback and Output were transposed.

Question 11 (c) (ii)

(ii) Flowcharts are also used to show processes.

What function does this symbol represent when used in a flowchart?



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

Candidates found this question very challenging with very few being able to identify the flowchart symbol as a decision/question/choice.

Question 12 (a) (i)

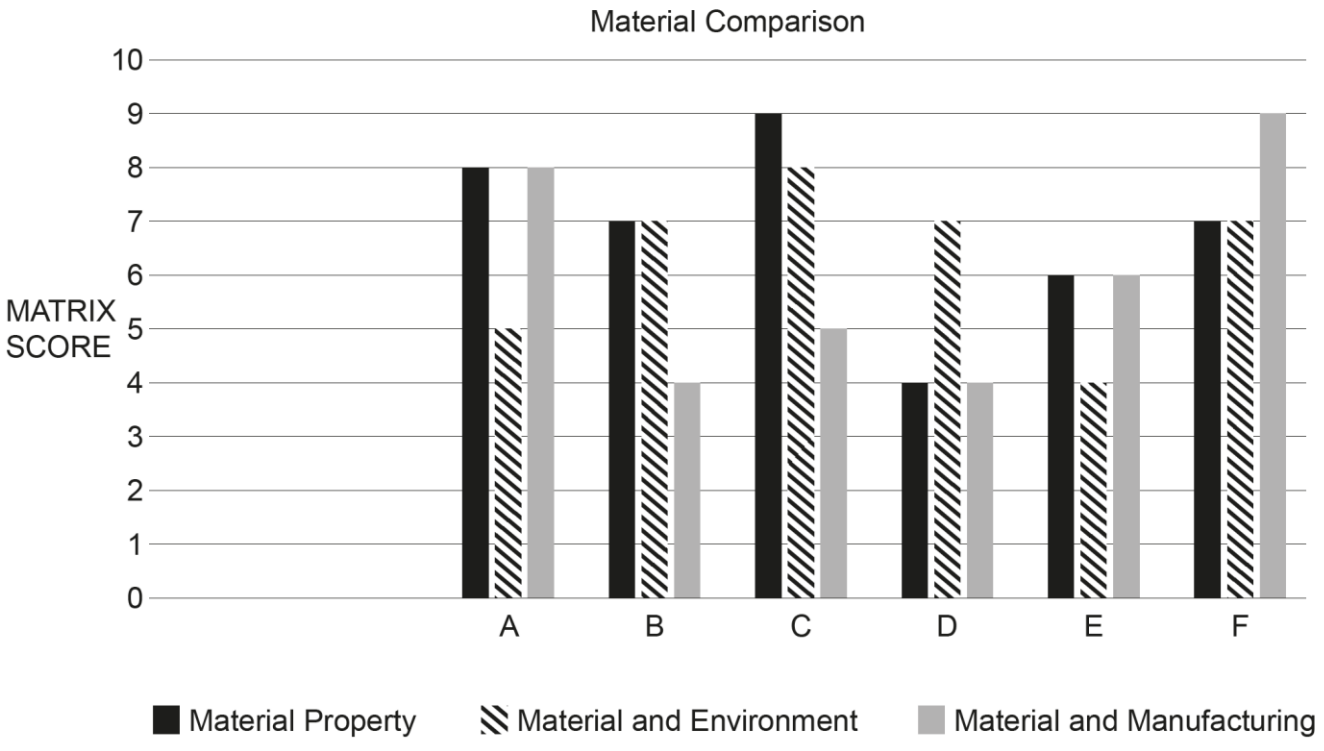
12 **Table 1** shows a ranking matrix to evaluate a choice of product materials (**A–F**). A score of 1 is the least suitable, and 10 is most suitable.

(a)
(i) Complete the ranking matrix for **Materials A** and **C** in **Table 1** using the graph in **Fig. 2**.

Table 1

Criteria	Materials					
	A	**B**	**C**	**D**	**E**	**F**
Material Property		7		4	6	7
Material and Environment	5	7	8	7	4	7
Material and Manufacturing	8	4	5	4	6	9

Fig. 2



[2]

Candidates found this question accessible and were often able to correctly identify Material A = 8 and Material C = 9.

Question 12 (a) (ii)

(ii) State which material (**A–F**) is the most suitable for the environment.

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

Most candidates were able to correctly identify material C.

Question 12 (a) (iii)

(iii) Explain how market research into materials used in existing products contributes to the design process.

.....

.....

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

This was a very well attempted question with many candidates gaining at least 1 mark, often 2. Candidates were able to clearly articulate and justify that gaining market research into materials used in existing products contributed to the design process. Candidates often made a relevant point and then extended or justified it or they made two sperate valid points.

Question 12 (b) (i)

(b)
(i) Explain **one** thing that engineers must consider when they select materials for manufacturing a product.

.....

.....

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

Candidates were able to explain one thing that engineers must consider when selecting materials for manufacturing a product. Sustainability/environmental issues were very popular responses although some candidates did not always extend or justify their responses.

Question 12 (b) (ii)

(ii) Use an example to explain why the material specified in a design specification might be changed for the final design.

.....

.....

.....

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

Candidates were regularly able to articulate why a material might be changed in the final design; the availability of a given material, budget considerations and user preferences (aesthetics/trends) were very popular responses.

Examples were not always given which limited the marks candidates could be awarded.

Question 13 (a) (i)

13 This is an aluminium flange spacer for mounting a motor.

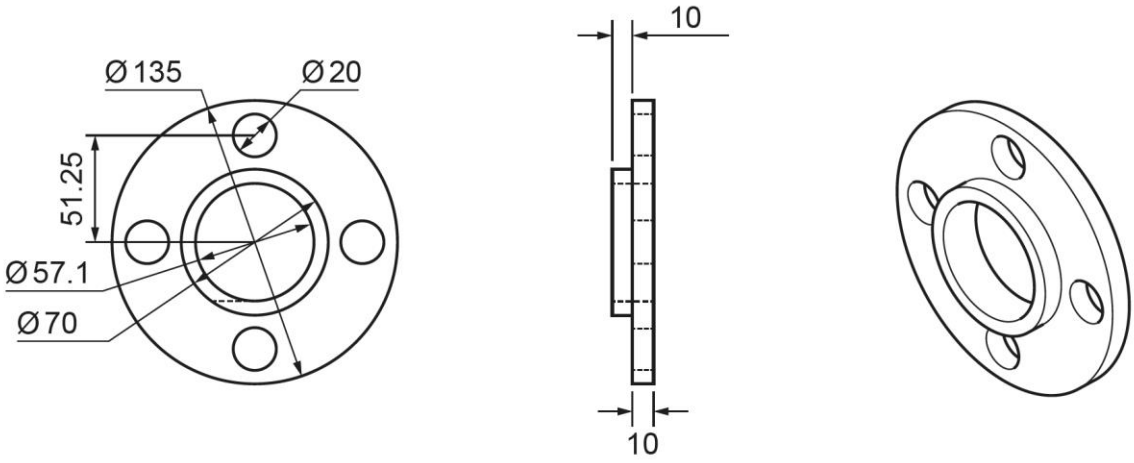
(a)

(i) In the space below, complete the third angle orthographic drawing by adding the **top view** of the spacer, using the correct drawing conventions.

Your drawing does **not** have to be drawn to scale.

You do **not** have to add measurements.

Top view



Front view **Right view** **Isometric view**

[3]

Engineering drawing conventions are of particular importance within the R038 specification. Consequently, marks were awarded in the following way: Correct shape (1) Correct hole convention (all holes, dashed lines for hidden details) (1) Correct orientation of flange (correct way up) (1) Candidates were often able to draw the correct shape in the correct orientation but did occasionally miss out the holes or place the flange upside down.

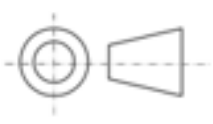
Question 13 (a) (ii)

(ii) Complete the drawing title block using standard conventions to add the following:

- abbreviation for 'Material'
- abbreviation for 'Drawing'
- Third Angle Projection symbol.

ALL DIMENSIONS IN mm			DO NOT SCALE
	Name	Date	Title:
Drawn	OCR	01/05/2024	FLANGE SPACER
Checked			
Approved			
..... Aluminium			..... No. 1230
.....			Scale: 1:1

[3]

ALL DIMENSIONS IN mm			DO NOT SCALE
	Name	Date	Title:
Drawn	OCR	01/06/2023	FLANGE SPACER
Checked			
Approved			
MATL Aluminium			**DRG** No. 1230
			Scale: 1:1

It appears that many candidates found abbreviating Materials and Drawing very challenging with very many examples of a variety of attempts, often with no abbreviations at all.

The third angle projection symbol was often incorrectly drawn and proved a challenge for candidates.

Question 13 (a) (iii)

(iii) State **one** suitable method that could be used to produce an accurate model of the spacer that can be viewed in 3D.

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

This was a very well attempted question with 3D printing and CAD being very popular responses from candidates.

Question 13 (b)

(b) Explain how modelling can be used to test the proportions of the design.

.....

.....

.....

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

This was a very well attempted question with candidates correctly identifying a number of ways that modelling can be used to test the proportions of the design. Candidate explanations covered many examples or scenarios with being able to see what a product looks like as a full-scale item, how components interact/fit together, how it feels in the hand and how it fits the intended environment whether on CAD or as a physical product all seen regularly.

Candidates often gained 2 marks and when a correct test was given within a scenario then justified full marks were attained.

Question 14 (a)

14 Evaluation of the design outcome is an important stage of the design process.

(a) State **one** tool that would be suitable for measuring an engineered product to ensure it meets specified tolerances.

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

This was another very well answered question, with steel rule and vernier callipers often cited. Some candidates misunderstood the question and gave hammer as the answer.

Question 14 (b)

(b) Use an example to explain why design features might be changed to improve a design.

.....

.....

.....

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

Candidates found this question accessible, correctly explaining a number of scenarios where a design feature might be changed to improve a design. Examples were not always given.

When an example was given, with reasoning on why the change would be needed and the impact or justification explained, full marks responses were often seen.

Exemplar 1

An example is a hand clamp. A designer could change the smooth grip on the handle to a textured grip called knurling, this would allow for a better grip when tightening. **[3]**

Exemplar 1 is correct and gained full marks. The example is given correctly, with a clear reason for change followed by what the change would be plus any impact explained.

Question 14 (c)

(c) Discuss the advantages and limitations of carrying out **user testing** as early as possible in the design process to evaluate design ideas.

.....

.....

.....

.....

.....

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

Many candidates discussed both the advantages and limitations of carrying out user testing as early as possible in the design process to evaluate design ideas. Gaining user opinions to gather further development of a product, highlighting flaws in the design to necessitate improvements and saving money on taking problems into production were all highlighted as advantages great throughout.

There were also some very good discussions around limitations such as the overall costs of testing, user sample sizes and their potential inherent bias toward a product.

Some candidates also discussed how there might be advantages in ensuring the product is fit for purpose and could gain early credibility within the market.

As shown in the mark scheme this is a levels response question, with the majority of candidates either achieving Level 1 or Level 2. Some candidates only covered one side of the discussion.

Some candidates achieved Level 3, demonstrating a thorough understanding of the advantages and limitations with consistent use or appropriate terminology.

Exemplar 2

A clear advantage would be that you could understand how good the design ideas are, so you could use them to narrow down which design to use, another advantage is that you could gather a better insight, to what would work, by looking at the results, the last advantage, is that you could recieve feedback, which could help to improve the design. A clear disadvantage is that it could be expensive to test the products, another disadvantage could be that if it's as early as possible, then the designs may not be ready, or good enough to be tested, so it could waste time, the last disadvantage, is that you would need to make a prototype to be tested, **[6]** which you may not have the right material or machinary for, so it could waste money, especialy if you don't use that idea, your just buying machinary that you will most likely not use.

Exemplar 2 is a Level 3 response and gained full marks. The response demonstrates a clear and coherent understanding of the advantages and limitations of carrying out user testing as early as possible in the design process and gives several valid reasons for this.

Question 15 (a) (i)

15 The table shows product requirements collected through market research for a prototype portable power bank.

Product requirements	Survey response count out of 100
(Function) 3 hours' recharge time	93
(Function) LED indicator to show charge status	64
(Function) Can charge at least two devices at the same time	51
Other survey comments collected	
(Aesthetics) 'Modern design'	
(Aesthetics) 'Sleek appearance'	
(Aesthetics) 'Easily identifiable'	
(Size) 'Can fit in pocket'	

(a)

(i) State **one** quantitative and **one** qualitative data finding from the research.

Quantitative data finding

.....

.....

Qualitative data finding

.....

.....

[2]

This was a well answered question with candidates being able to state one quantitative and one qualitative piece of data. Some candidates did transpose the information and so answered incorrectly.

Question 15 (a) (ii)

(ii) Explain why it is important to prepare a design specification.

.....

.....

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

Candidates were able to explain a wide range of reasons for preparing a design specification. Providing clear instructions, product requirements and an outline of the wants and needs of the customer were very popular responses.

Candidates often made a relevant point and then extended or justified it or they made two sperate valid points. Some candidates appeared to repeat the question.

Question 15 (b)

(b) Materials can come in a range of shapes, sizes or forms of supply.

Give **one** example of a material.

State a form that the material could be supplied in.
State a method of shaping the material during manufacture.

Material .....

Material form .....

Method of shaping .....

[2]

A wide variety of responses were seen. When a suitable material form was stated, often a correct method of shaping followed. However, there were many instances where they did not follow and were not actually achievable for the material given.

The specification requires students to have knowledge of material availability and form, and the differing types of manufacturing processes typically used for each. The manufacturing processes are listed within 2.2 of the qualification specification.

Question 15 (c)

(c) Explain **two** ways that **capital** cost could limit the scale of production.

1 .....

.....

.....

2 .....

.....

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

Candidates found it very challenging to explain how capital cost could limit the scale of production. The majority of candidates gave answers that were unrelated to capital costs, with relatively few correctly giving answers related to land, buildings/ premises, set-up costs, equipment/machinery.

Question 16 (a)

16 Products are designed using different design strategies.

(a) Describe what **linear design** is.

.....

.....

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

Candidates found it very challenging to describe what linear design is. Topic area 1: design strategies 1:1 The stages involved in design processes feature in the teaching content within the specification.

Question 16 (b) (i)

(b)

(i) A designer is working on a design brief for new gym equipment.

State **two** drawing techniques that could be used to develop **initial** design ideas.

1 .....

2 .....

[2]

Candidates found this question very accessible. A wide range of correctly stated drawing techniques were seen. Freehand, isometric and oblique were popular responses.

Question 16 (b) (ii)

(ii) Anthropometric data gives measurements of the human body.

Evaluate the benefits of using anthropometric data when designing gym equipment.

.....

.....

.....

.....

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

Candidates were able to evaluate the benefits of using anthropometric data when designing gym equipment, often stating one or more key principles. Inclusivity with regard to allowing ergonomic and comfortable access to a broad cross section of people was a very popular response. Percentile ranges, adjustability and the opportunity to have generic equipment were also regularly explained. Overall, this was a very well understood topic with many candidates gaining at least 2 marks and often more.

Exemplar 3

You could use the anthropometric data, to create machines that are comfortable to use, as they are shaped to fit the human hand, for instance they use hand ~~measure~~ measurements to create a barbell, which is easier to hold, this is called ergonomic design. This would also cause the Product to sell better, as it's a higher quality product. **[4]**

Exemplar 3 shows clear understanding of how anthropometric data can be demonstrated. Specific examples are then given to help justify the impact of using the data.

Question 16 (b) (iii)

(iii) State **two** reasons a designer would model the gym equipment before finalising the design.

1 .....

2 .....

[2]

Candidates found this question very accessible, although on occasion some did simply repeat the same answer twice in different words.

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