OCR
Oxford Cambridge and RSA

# Thursday 9 May 2024 – Morning

## Level 1/Level 2 Cambridge National in Engineering Design

**R038/01** Principles of engineering design

**Time allowed: 1 hour 15 minutes**

**You must have:**
- a ruler (cm/mm)

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

**INSTRUCTIONS**
- Use black ink. You can use an HB pencil, but only for diagrams.
- Write your answer to each question in the space provided. You can use extra paper if you need to, but you must clearly show your candidate number, the centre number and the question numbers.
- Answer **all** the questions.

**INFORMATION**
- The total mark for this paper is **70**.
- The marks for each question are shown in brackets **[ ]**.
- Dimensions are in millimetres unless the question says something different.
- This document has **16** pages.

**ADVICE**
- Read each question carefully before you start your answer.

## Section A

Put a tick (✓) in the box next to the **one** correct answer for each question.

**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]**

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

**(a)** Mass ☐

**(b)** Material ☐

**(c)** Measurement ☐

**(d)** Model ☐ **[1]**

**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]**

**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]**

**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]**

**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]**

**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]**

**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]**

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

**(a)** ∅ ☐

**(b)**  ☐

**(c)** 

☐

**(d)**  ☐ **[1]**

**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]**

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## Section B

**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]**

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

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

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

**(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]**

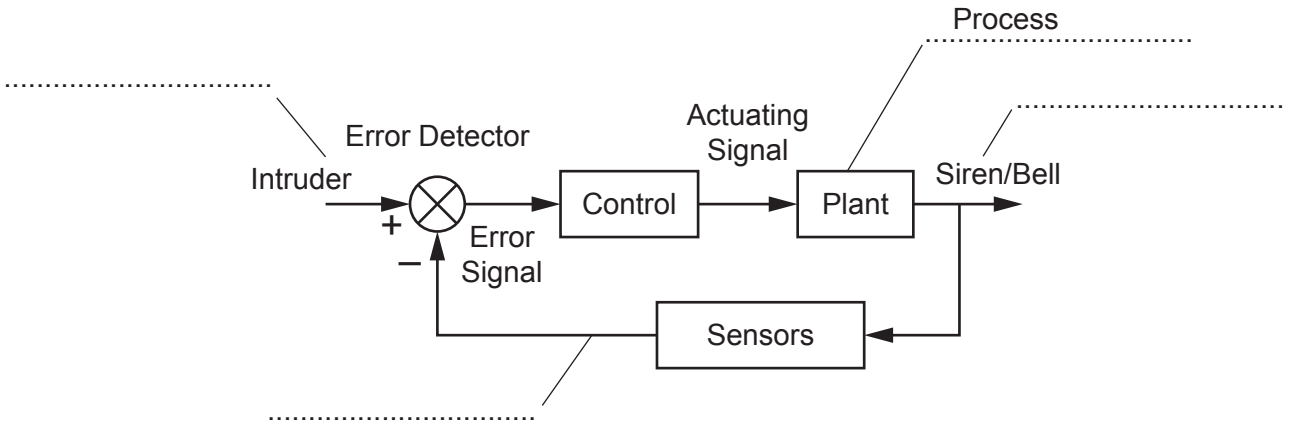
**(c)**

**(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.

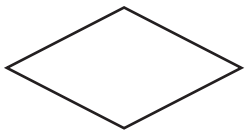
**Block** **Feedback** **Input** **Output** ~~**Process**~~




**[3]**

**(ii)** Flowcharts are also used to show processes.

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



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

**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.

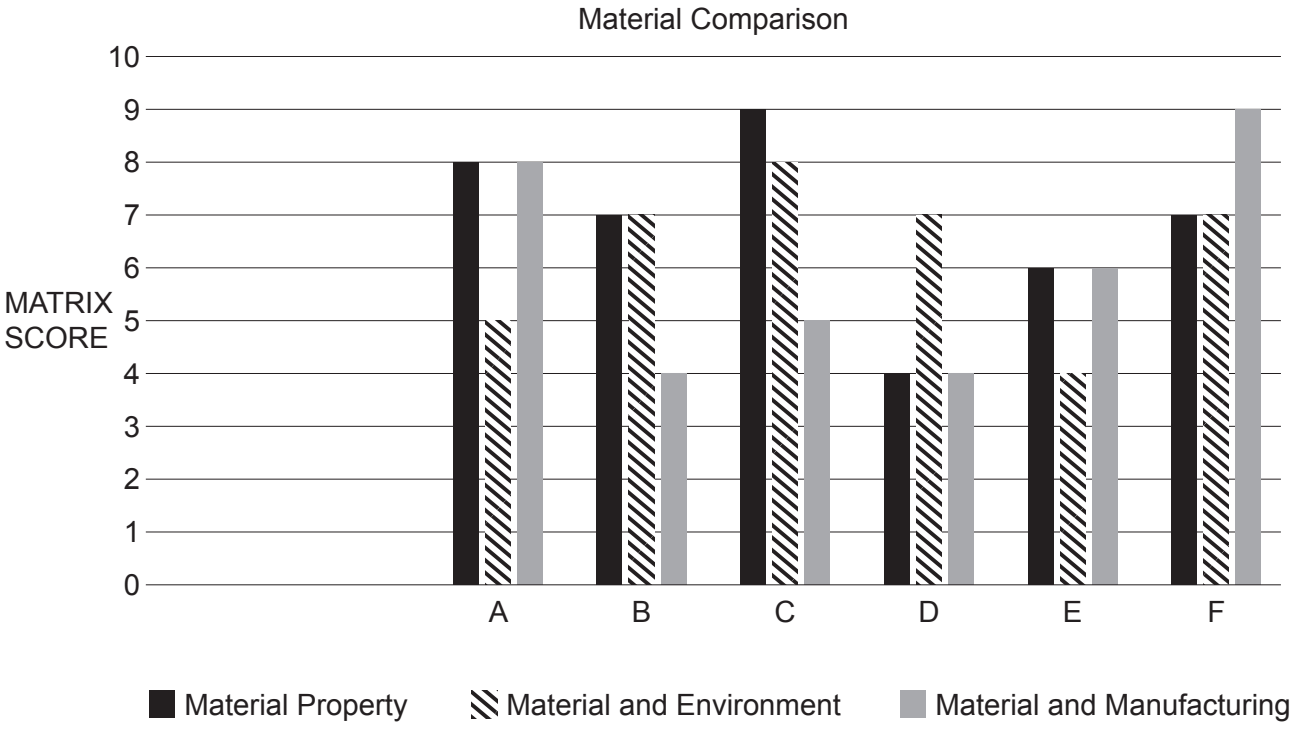
**(a)**

**(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]**

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

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

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

.....

.....

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

**(b)**

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

.....

.....

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

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

.....

.....

.....

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

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

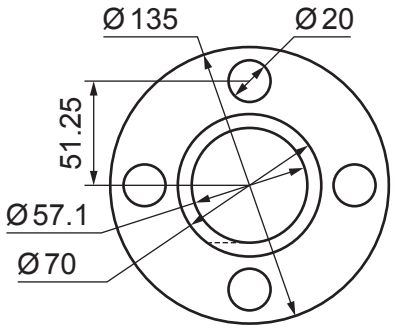
**(a)**

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

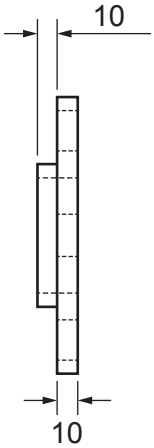
Your drawing does **not** have to be drawn to scale.

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

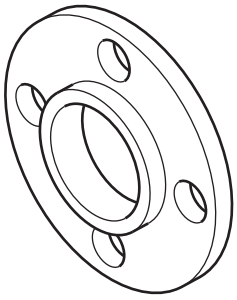
**Top view**




**Front view**




**Right view**



**Isometric view**

**[3]**

**(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]**

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

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

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

.....

.....

.....

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

**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]**

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

.....

.....

.....

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

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

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

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**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]**

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

.....

.....

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

**(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]**

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

1 .....

.....

.....

2 .....

.....

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

**16** Products are designed using different design strategies.

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

.....

.....

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

**(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]**

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

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

.....

.....

.....

.....

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

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

1 .....

2 .....

**[2]**

**END OF QUESTION PAPER**