ENGINEERING MANUFACTURE

INCLUDED ON THE
KS4 PERFORMANCE TABLES

Examiners' report

OCR Level 1/Level 2

Cambridge National in

Engineering Manufacture

J823

For first teaching in 2022 | Version 1

R014 January 2025 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 Teach Cambridge.

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R014 series overview

This paper contained two sections of questions covering the principles of engineering manufacture. Section A comprised of ten multiple choice questions relating to manufacturing processes and requirements, material properties and developments in engineering manufacture. Section B comprised of six sets of questions where candidates were required to:

- identify and explain evaluate suitable materials for a commercial passenger aeroplane wing
- demonstrate an understanding of the 3D printing process
- demonstrate their understanding of lean manufacturing and powder coating
- demonstrate an understanding of the manufacturing processes required to accurately drill a hole
- demonstrate their understanding of automated manufacture
- interpret orthographic third angle projection drawing conventions.

To do well in this paper, candidates needed a fundamental understanding of material properties and the additive manufacturing process, the categories of waste in relation to lean manufacturing, how automated control can be utilised to manufacture specific products and the advantages and disadvantages of using jigs in mass manufacture. Candidates also needed to be able identify the standard drawing conventions used in orthographic projection.

To do well in extended writing responses, candidates needed to make sure that the points made were justified. For example, when stating advantages and disadvantages of using jigs in mass manufacture, they needed to explain why rather than simply stating the point. Many excellent responses detailed how jigs can be utilised in the manufacturing process with specific examples supporting the advantages and disadvantages stated.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• were able to successfully identify suitable materials and properties • demonstrated good knowledge of the additive manufacturing process • demonstrated a clear understanding of the categories of waste in relation to lean manufacturing • were able to appropriately explain and justify their responses when required • demonstrated a good knowledge of safety measures when manufacturing • showed a good understanding regarding the use of jigs when mass manufacturing products.	• gave generic responses that did not relate to the context of the question • overlooked the specifics of questions that related directly to the provided stimulus • struggled to identify material properties • struggled to describe manufacturing processes • struggled to identify the abbreviations and line types used within orthographic third angle projection drawings.

Section A overview

Section A contained ten multiple choice questions requiring candidates to identify one correct answer for each question.

Question 1

1 Which type of fastener creates its own thread as it is driven into a material?

(a) Hammered rivet ☐

(b) Pop rivet ☐

(c) Nut and bolt ☐

(d) Self-tapping screw ☐

[1]

Most candidates correctly identified 'Self-tapping screw'.

Question 2

2 Which wasting process uses a thin beam to melt the material?

(a) Filing ☐

(b) Laser-cutting ☐

(c) Milling ☐

(d) Turning ☐

[1]

Most candidates correctly identified 'Laser-cutting'.

Question 3

3 Which of these is a specific consideration of globalisation?

(a) Automation ☐

(b) Defects ☐

(c) International standards ☐

(d) Quality control ☐

[1]

While most candidates were able to correctly identify 'International standards' as the correct response, many often selected 'Automation'.

Question 4

4 Which of these describes hardness as a material property?
The ability of a material to:

(a) be drawn into thin wire ☐

(b) resist scratches and abrasion ☐

(c) withstand pulling forces ☐

(d) withstand stretching forces ☐

[1]

Most candidates were able to correctly identify 'resist scratches and abrasion'.

Question 5

5 Which is an engineering ceramic material?

(a) Epoxy resin ☐

(b) Photochromic pigment ☐

(c) Shape memory alloy ☐

(d) Tungsten carbide ☐

[1]

While most candidates were able to correctly identify 'Tungsten carbide' as the correct response, a large number often selected 'Epoxy resin'.

Question 6

6 What is BS 8888 the standard for?

(a) Engineering drawing conventions ☐

(b) Environmental practices ☐

(c) Finishing processes ☐

(d) Waste management procedures ☐

[1]

This question drew a range of responses with candidates often split between 'Engineering drawing conventions' (correct) and 'Waste management procedures.'

Question 7

7 Which of these describes quality assurance?

(a) A preventative approach to quality, measuring parts ☐

(b) A preventative approach to quality, putting in place systems to reduce defects ☐

(c) A reactive approach to quality, measuring parts ☐

(d) A reactive approach to quality, putting in place systems to reduce defects ☐

[1]

This question drew a range of responses. The correct answer is 'a preventative approach to quality, putting place systems to reduce defects.'

Question 8

8 Which of these describes batch production?

(a) Continuous production 24 hours a day 7 days a week ☐

(b) High volume production of products ☐

(c) Individual one-off prototype production ☐

(d) Production of products in small groups over a set time ☐

[1]

Most candidates correctly identified 'Production of products in small groups over a set time' however 'High volume production of products' or 'Continuous production 24 hours a day 7 days a week' were often incorrectly identified.

Question 9

9 Which material is a thermosetting polymer?

(a) Acrylonitrile-Butadiene-Styrene ☐

(b) High impact polystyrene ☐

(c) Polycarbonate ☐

(d) Urea formaldehyde ☐

[1]

Most candidates were able to correctly identify 'Urea formaldehyde'.

Question 10

10 What is material requirements planning (MRP) a type of?

(a) Drawing standard ☐

(b) Inventory management system ☐

(c) Material supply ☐

(d) Quality control system ☐

[1]

This question drew a range of responses. The correct answer is 'Inventory management system'.

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 need 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 properties of a material.

Describe, explain, evaluate 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 manufacturing scenario or material application 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 answers that include a reasoned discussion/debate with appropriate use of terminology.

Question 11 (a)

11 A manufacturing company produces wings for commercial passenger aeroplanes, like the one shown below.

(a) Identify **one** material that would be suitable for the aeroplane wings.

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

Candidates generally responded well to this question. Aluminium or carbon fibre were the most popular answers, however many incorrectly answered with 'metal' or 'steel'.

Question 11 (b)

(b) State **two** typical forms of supply of your material in Part **(a)**.

1 .....

2 .....

[2]

Candidates often accessed both marks available. Those responses that were not given credit often misinterpreted the question, providing responses relating to melting points or the type of metal.

Question 11 (c)

(c) Evaluate how the **properties** of your material make it suitable for the aeroplane wings.

.....

.....

.....

.....

.....

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

This question was generally answered well. The most common correct answers referenced were 'lightweight' and 'strength'. Candidates were generally able to provide a relevant supporting explanation.

Question 11 (d)

(d) State **three other** typical applications of your material.

1 .....

.....

2 .....

.....

3 .....

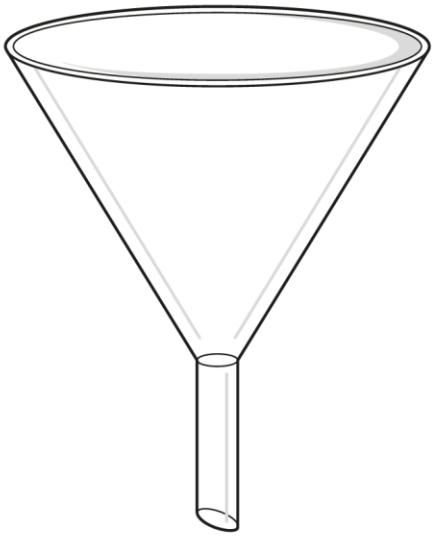
.....

[3]

Many single word generic products were stated for this question. It is important for candidates to give specific applications to access the full range of marks available.

Question 12 (a)

12 You are manufacturing a funnel, like the one below.



(a) Describe **four** steps required to manufacture this product using **3D printing** (fused deposition modelling).

1 .....

.....

2 .....

.....

3 .....

.....

4 .....

.....

[4]

Candidates often accessed at least 2 of the 4 marks available. Those responses that were not given credit often focused on the design on the funnel rather than the manufacturing.

Question 12 (b)

(b) Explain **one** safety measure that should be taken when using a 3D printer to manufacture this product.

.....

.....

.....

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

This question was generally answered well and a clear understanding of safety measures relating to 3D printing were often presented.

Question 12 (c)

(c) Explain **two** reasons why additive processes are suitable for manufacturing this product.

1 .....

.....

.....

.....

2 .....

.....

.....

.....

[4]

Candidates responded well to this question, often accessing at least 3 of the 4 marks available.

Question 13 (a)

13

(a) Complete the table below to describe each category of waste in **Lean manufacturing**. State how reducing each waste improves the performance of manufacturing.

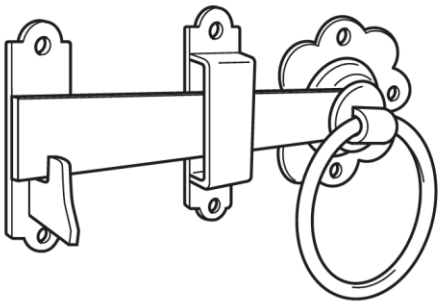
An example is provided.

Category of waste	**Description of category of waste**	**How reducing it improves the performance of manufacturing**
Over-processing	*Performing processes that are not needed by the customer.*	*Reducing this saves production time.*
Transportation	**[1]**	**[1]**
Over-production	**[1]**	**[1]**
Defects	**[1]**	**[1]**

Candidates often struggled with the description for transportation as a category of waste and responses often omitted the key term 'excessive'. Responses for the descriptions of over-production and defects were often correct. The improving performance column was mostly answered correctly, but the necessary detail was often missing when referring to 'time' which often was not qualified.

Question 13 (b) (i)

(b) A garden gate latch similar to the one shown below will be manufactured from low carbon steel.



The manufacturer offers a range of finishings for the garden gate latch.

The table below shows a comparison of the finishing processes, where a score of 1 is the lowest and 5 is the highest.

Finishing process	Time	Processing	Cost
Painting	1	1	2
Powder coating	3	5	3
Galvanising	5	3	5

(i) State why the manufacturer might produce more garden gate latches using painting, than the other finishing processes.

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

This question was generally answered very well with most candidates correctly stating points in relation to 'less time/cost'.

Question 13 (b) (ii)

(ii) Explain what **powder coating** is.

.....

.....

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

Candidates often correctly identified that powder coating provides a durable or protective layer and were given 1 mark however they often did not refer to electrically charged particles or the spraying/application of powder.

Question 13 (b) (iii)

(iii) State **one** advantage of powder coated finishing compared to painting.

.....

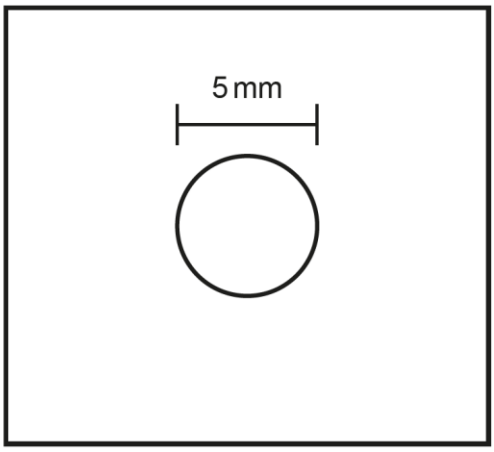
..... **[1]**

This question was well received by candidates with most correctly identifying advantages relating to durability.

Question 14 (a)

14 A hole of 5 mm diameter will be drilled through a thin piece of plastic, as shown below.

There is a tolerance of **± 0.2 mm** for this diameter.



(a) Calculate the maximum and minimum acceptable diameters for the hole.

Maximum .....

.....

Minimum .....

.....

[2]

Candidates responded well to this question in the main. Occasionally candidates would place the decimal point incorrectly but most accessed both marks available.

Question 14 (b)

(b) Describe **four** steps required to accurately drill the hole.

1 .....

.....

2 .....

.....

3 .....

.....

4 .....

.....

[4]

Candidates generally responded well to this question with a rage of appropriate steps provided to accurately drill the hole. Those candidates who performed less well often repeated their steps.

Question 14 (c)

(c) Explain **two** safety measures that should be taken when drilling the hole.

1 .....

.....

.....

2 .....

.....

.....

[4]

This question was generally answered very well with most candidates correctly identifying two different safety measures.

Explain questions

When considering their response to an explain question, candidates should be encouraged to support the point they are making with a relevant example or justification in order to access the full range of marks available.

Question 15 (a)

15

(a) Mass manufacturing often involves the use of automated systems.

Describe how **fully automated robotic control** is used to manufacture **two** products.

1. Product .....

How it is manufactured .....

.....

.....

2. Product .....

How it is manufactured .....

.....

.....

[4]

Responses were varied to this question. Candidates were often able to identify appropriate products however some of the descriptions of the manufacturing processes did not link or refer to the product identified.

Question 15 (b)

(b) Jigs are often used when mass manufacturing products.

Discuss the advantages and limitations of using jigs when mass manufacturing products.

.....

.....

.....

.....

.....

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

Level 3 responses were able to clearly identify different advantages and disadvantages of using jigs when in mass manufacturing products. Typically, these responses presented two or more points for both advantages and disadvantages while demonstrating a clear understanding regarding the use of jigs.

Level 2 responses tended to identify and explain both advantages and disadvantages but did not offer sufficient clarity as to the relationship of these to mass manufacturing.

Level 1 responses often either focused solely on advantages or disadvantages regarding the use of jigs.

Exemplar 1

- Another advantage of jigs is that they reduce the amount of human error because the operator no longer has to replicate the design themselves, increasing the rate of production.
- A third advantage is that they reduce the amount of time needed to produce a product.
- However, one disadvantage is that each jig needs to made to fit a single product, meaning that a factory can only produce one product. **[6]**
- Another disadvantage is that jigs reduce the flexibility of the production process as the manufacturers can only make one type of product.
- A final disadvantage is that jigs can be expensive to make when a product is being mass produced.

Exemplar 1 shows an extract from a Level 3 response where the candidate clearly identifies numerous advantages and disadvantages of using jigs in mass manufacture. Each point is supported by an explanation and appropriate terminology.

Question 16 (a) (i), (ii), (iii) and (iv)

16

(a) State what **each** of the following abbreviations used on orthographic drawings stand for.

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

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

(iii) MAT ..... **[1]**

(iv) SQ ..... **[1]**

Responses were varied for these questions. Candidates were mostly able to correctly state 'Diameter' for part (ii) and 'Material' for part (iii) however many candidates did not provide a response for part (i) or (iv).

Assessment for learning

It is important that students cover the full range of the specification as part of their learning journey. The abbreviations for orthographic third angle projection drawings are outlined in the specification document in Topic Area 3.1.

Question 16 (b) (i) and (ii)

(b) Explain what each of the following lines mean in an orthographic drawing.

(i)

.....

.....

.....

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

(ii)

.....

.....

.....

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

These questions were generally answered well with candidates achieving at least 1 mark for each. However, many candidates often confused the two lines, incorrectly identifying part (i) as a 'centre line' and part (ii) as a 'hidden line'.

Question 16 (c)

(c) A drawing shows that a product must be manufactured from sustainable materials.

Explain what **sustainable** means.

.....

.....

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

Responses to this question were varied with candidates often misinterpreting the question and explaining points related to strength and durability.

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