OCR
Oxford Cambridge and RSA

Thursday 23 May 2024 – Afternoon

Level 1/Level 2 Cambridge National in Engineering Manufacture

R014/01 Principles of engineering manufacture

Time allowed: 1 hour 15 minutes

You can use:
- a calculator

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.
- 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 **[ ]**.
- This document has **20** 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 of these joining processes needs heat?

(a) Brazing ☐

(b) Nuts and bolts ☐

(c) Pop rivets ☐

(d) Self-tapping screws ☐

[1]

2 What type of process is shearing?

(a) Forming ☐

(b) Joining ☐

(c) Shaping ☐

(d) Wasting ☐

[1]

3 Which of these means the ability to be drawn into wires?

(a) Compressive ☐

(b) Ductility ☐

(c) Elasticity ☐

(d) Malleability ☐

[1]

4 Which of these is a forming process?

(a) Die casting ☐

(b) Forging ☐

(c) Injection moulding ☐

(d) Powder metallurgy of ceramic products ☐

[1]

5 Which of these is a thermoplastic?

(a) Acrylonitrile-Butadiene-Styrene ☐

(b) Melamine formaldehyde ☐

(c) Polyester resin ☐

(d) Urea formaldehyde ☐

[1]

6 What kind of material is glass reinforced polymer?

(a) Ceramic ☐

(b) Composite ☐

(c) Metal ☐

(d) Smart material ☐

[1]

7 What type of line is this on an orthographic drawing?

(a) Dimension ☐

(b) Leader line ☐

(c) Outline ☐

(d) Projection ☐

[1]

8 Which of these is a property of silicon carbide?

(a) High density ☐

(b) High ductility ☐

(c) High hardness ☐

(d) High machinability ☐

[1]

9 Which of these is a specific shape used to draw around to help cut out other materials in a same shape and size?

(a) Fixture ☐

(b) Jig ☐

(c) Mould ☐

(d) Template ☐

[1]

10 Which of these is represented by a patterned surface on an orthographic drawing?

(a) Chamfer ☐

(b) Countersink ☐

(c) Hole ☐

(d) Knurl ☐

[1]

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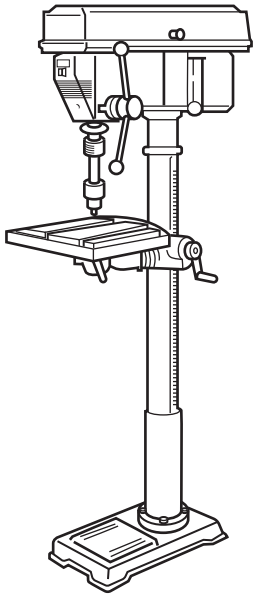
Section B

11 You are manufacturing a product using the machine below.

(a) Add labels to the machine to identify the **chuck** and the **column**. **[2]**



(b) Identify **three** hazards when operating the machine above.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

(c) State **three different** pieces of PPE that should be worn when using this machine.

1 .....

2 .....

3 .....

[3]

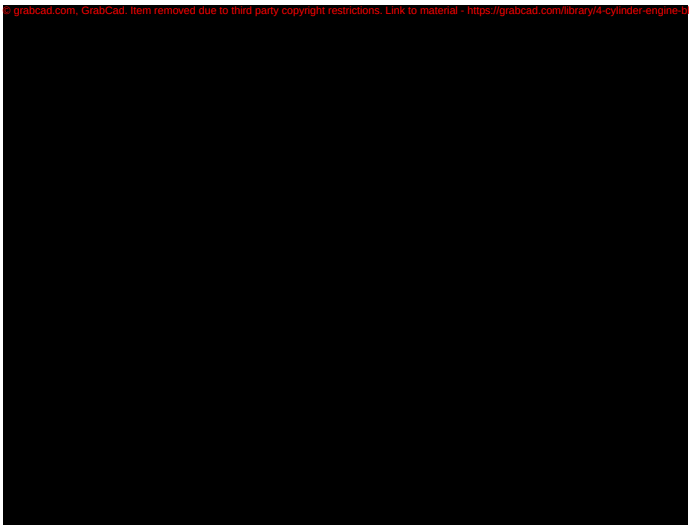
(d) State **two** safety features you would expect to find on or near this machine.

1 .....

2 .....

[2]

12 An engineering company is using a non-ferrous metal to manufacture engine blocks like this.



(a) State **two** non-ferrous metals.

1 .....

2 .....
[2]

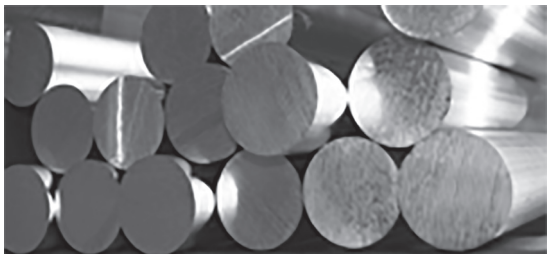
(b) State **one** reason why a non-ferrous metal would be more suitable than a ferrous metal for this product.

.....

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

(c) Metal is available in a variety of forms of supply.

Identify these forms.



1 .....

2 .....

3 .....

[3]

(d) The engine blocks will be manufactured by sand casting.

(i) Explain why the stock form is **not** important when sand casting.

.....

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

(ii) Explain why products manufactured by **sand casting** need further finishing once removed from the mould.

.....

.....

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

(iii) Explain why sand casting produces very little wasted metal even though a large proportion of defective products are made.

.....

.....

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

13 Different types of materials can be used in engineering.

(a) Use the materials below to identify an example of each type of engineering material.

Not all the example materials are used.

One has been completed for you.

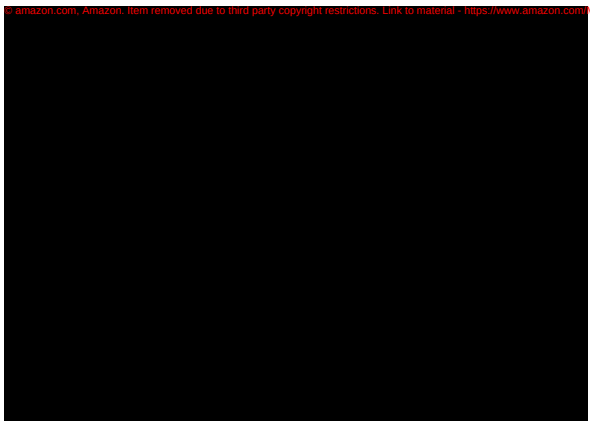
Carbon Fibre **~~Cast Iron~~** **Silicon Carbide**

Titanium **Quantum Tunnelling Composite**

Type of engineering material	**Example materials**
Engineering Ceramic	
Ferrous metal	Cast iron
Smart material	

[2]

(b) These bath toys contain a smart material which changes colour when put into warm water.



(i) Explain what a **smart material** is.

.....

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

(ii) Identify the type of smart material used in the bath toys.

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

(c) Identify **one** use of **tungsten carbide** and state **one** property that makes it suitable for this use.

Use .....

Property .....

[2]

(d) Identify **one** use of a **shape memory alloy** and explain why it is suitable for this use.

Use .....

Why it is suitable .....

.....

.....

.....

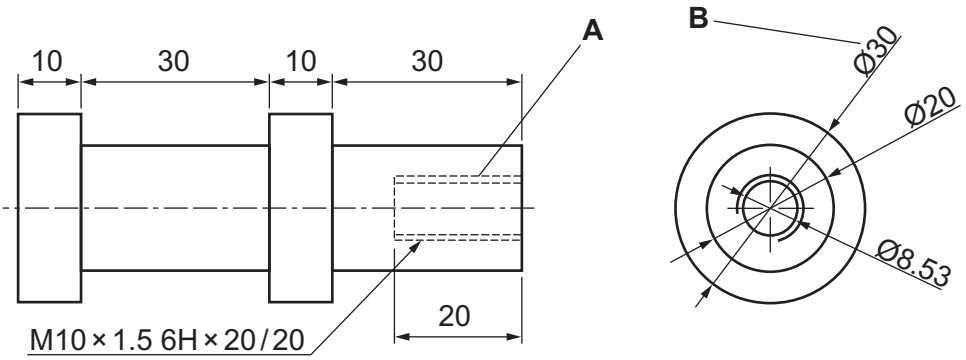
.....

[3]

14 This is an orthographic drawing that will be used to manufacture a component.

The component will be manufactured from 30 mm stainless steel rod.

All dimensions are in mm.



(a) State **two** mechanical features shown by label **A**.

1 .....

2 .....

[2]

(b) State the dimension shown by label **B**.

30 mm ..... **[1]**

(c) State **one** machining process that could be used to manufacture the component in the orthographic drawing above.

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

(d) Consider the following statement:

Both a lathe and a press brake machine are needed to make the component in the orthographic drawing on **Page 12**.

How far do you agree with this statement? Give reasons for your answer.

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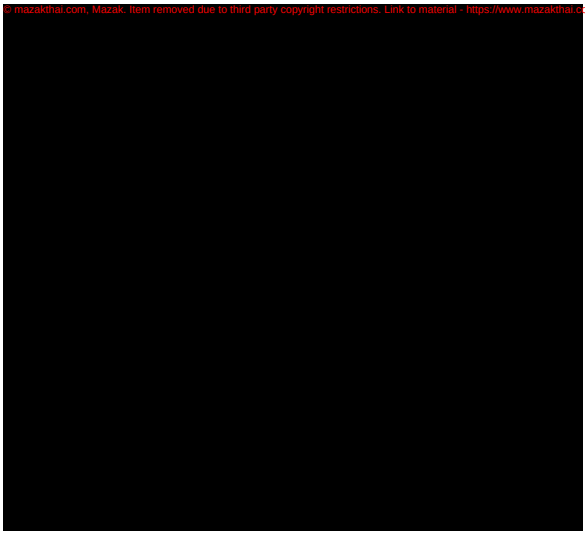
..... **[6]**

15 A multi-axis machine is one example of a machine used in Computer Aided Manufacturing (CAM).

This is a multi-axis machine being used to manufacture a product.



(a) What is **Computer Aided Manufacturing** (CAM)?

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

(b) Identify **one** CAM machine that can be used for **wasting processes**, other than a multi-axis machine.

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

(c) Identify **one** product which can be **mass** manufactured using CAM.

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

(d) Identify **one** product that is **batch** manufactured using CAM.

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

(e) CAM is often used for mass manufacture.

Discuss the advantages and disadvantages of using CAM in **both** mass **and** one-off manufacturing.

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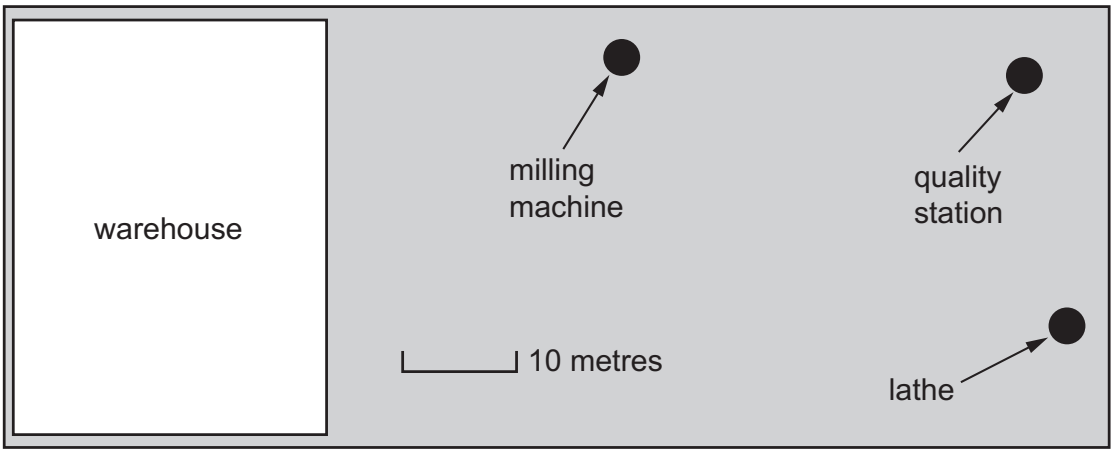
..... **[6]**

16 Companies use **lean manufacturing** to increase profitability by reducing waste.

This is a plan of a large manufacturing facility viewed from above.



There are seven steps in the production plan:

1. Raw materials are stored in the warehouse.
2. Raw materials are taken from the warehouse to the lathe.
3. Raw materials are turned on the lathe.
4. The turned parts are taken to the milling machine.
5. The turned parts have material removed on the milling machine.
6. The finished parts are measured at the quality station to check that their dimensions are within tolerance.
7. The finished parts are stored in the warehouse until the customer buys them.

(a)
(i) Identify the category of waste in **Step 4** and explain **two** ways that this waste can be reduced.

Waste .....

How it can be reduced

1 .....

.....

2 .....

.....

[3]

(ii) The category of waste in **Steps 1** and **7** is **inventory**.

Explain **three** ways that **Just-In-Time** (JIT) will reduce inventory waste.

1 .....

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2 .....

.....

3 .....

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[3]

(b) Explain why **Step 6** is a **quality control** approach, and why it is **not quality assurance**.

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

END OF QUESTION PAPER

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