



Oxford Cambridge and RSA

Wednesday 11 January 2023 – Afternoon

Level 1/2 Cambridge National In Engineering Manufacture

R109/01 Engineering materials, processes and production

Time allowed: 1 hour



No extra materials are needed.



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 graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.

INFORMATION

- The total mark for this paper is **60**.
- The marks for each question are shown in brackets [].
- Quality of written communication will be assessed in questions marked with an asterisk (*).
- This document has **16** pages.

ADVICE

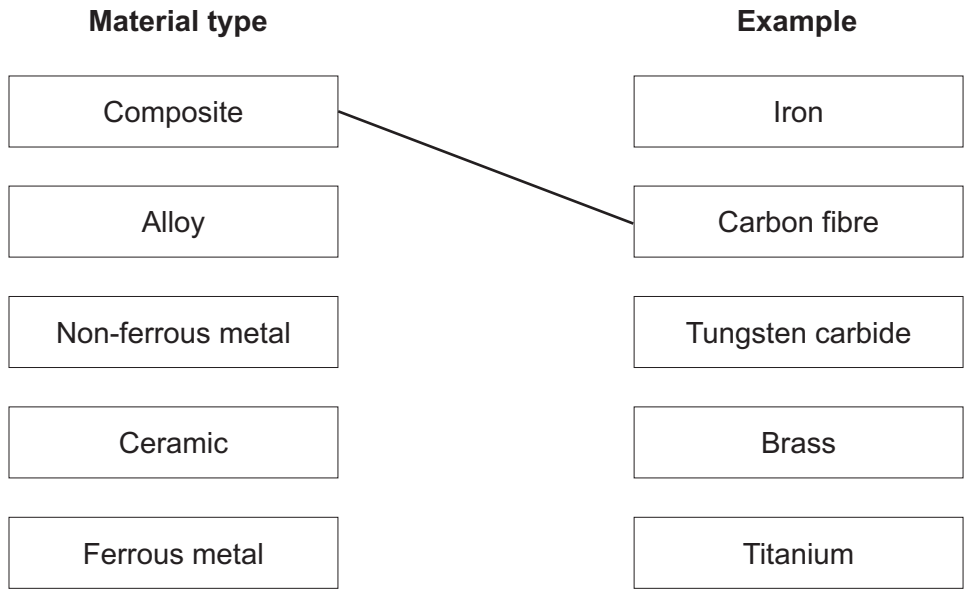
- Read each question carefully before you start your answer.

Answer **all** the questions.

1 Many different materials are used in engineering.

(a) Draw lines to link the material type to the correct example.

One has been completed for you.



[3]

(b) **Circle one** destructive test from the list below that can be carried out on metals.

conductivity testing

crack detection

tensile testing

[1]

(c) Describe what is meant by 'hardness' in a metal.

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

(d) The ductility of a metal can be increased by using the normalising process.

Explain what ductility means and how normalising affects the structure and ductility of the metal.

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

(e) Give **one** use of tungsten carbide.

..... [1]

2 (a) Fig. 1 shows a safety helmet with visor worn by lifeboat crew.

The visor is made of polycarbonate. The shell of the helmet is made of acrylonitrile butadiene styrene (ABS).

Fig. 1



(i) State the property that makes polycarbonate, but not ABS, suitable for the **visor**.

..... [1]

(ii) State **two** properties of ABS that makes it suitable for use in safety helmets.

1

.....

2

.....

[2]

(iii) The polycarbonate raw material is available in sheet or powder form.

State the most appropriate method of manufacturing the visor from these different forms of raw material.

Polycarbonate sheet

Polycarbonate powder

[2]

(b) Tow ropes on lifeboats are manufactured from nylon because they require high elasticity.

State the meaning of 'elasticity'.

.....

..... [1]

- (c) Place a tick (✓) in the correct column in the table below to show if the material is a thermoplastic or thermosetting plastic.

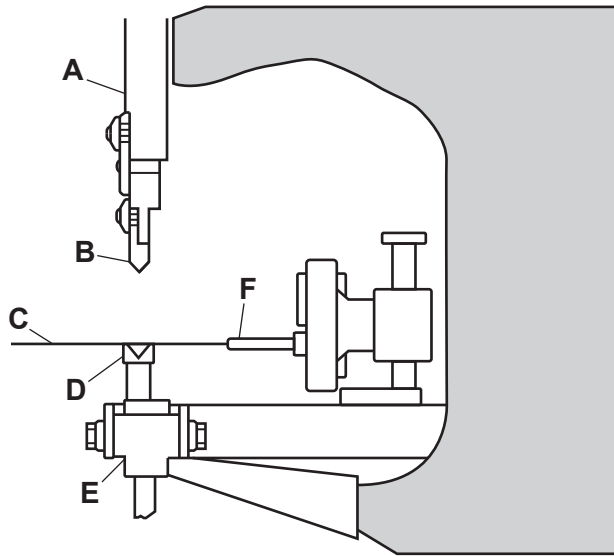
Polymer material	Thermoplastic	Thermosetting plastic
polycarbonate		
ABS		
nylon		
phenol-formaldehyde		

[4]

3 (a) Fig. 2 is an end view of a press brake machine, used to shape metal.

Parts of the machine are identified with labels.

Fig. 2



(i) State the letters in Fig. 2 that label the following parts of the press brake machine.

Part of the press brake machine	Letter
Die	
Punch	
Hydraulic ram	

[3]

(ii) State **two** safety features, other than PPE, that you would find near a press brake machine.

1

2

[2]

(iii) Describe the safety precautions that should be taken before operating a press brake machine.

.....

 [2]

(b) Fig. 3 shows three examples of metals that require a joining method.

Next to each example below, state the most appropriate joining method from the following:

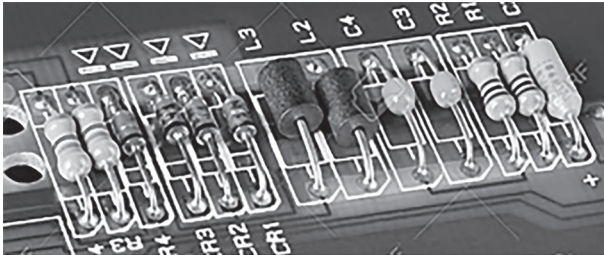
brazing

soldering

welding

Each method can be used once, more than once or not at all.

Fig. 3



components to a printed circuit board

.....



aluminium tubing in cycle frames

.....



copper pipes

.....

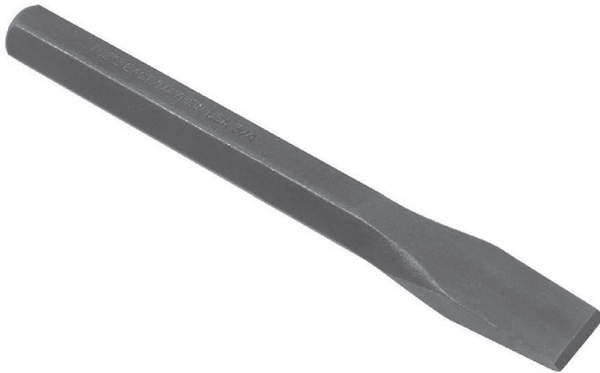
[3]

7
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- 4 (a) Fig. 4 shows a cold chisel.

Fig. 4



- (i) The stages of manufacture for the chisel are given below.

Put the stages into the correct sequence by drawing lines to connect the sequence number to the correct stage.

One has been completed for you.

Sequence

Stage

1	Grind cutting edge onto the chisel
2	Heat to an orange colour and quench in water
3	Cut a 20 cm length from the hexagonal stock using a hacksaw
4	Hammer into shape on an anvil
5	Heat one end of the stock material in a furnace
6	Allow chisel to cool

[4]

(ii) The next stage in manufacturing the chisel is to temper the cutting edge.

Describe how the cutting edge of the chisel is tempered after it has been cleaned.

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

(iii) Explain why the cutting edge of the chisel should be tempered.

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

(b) Cold chisels can be used to manually cut grooves into metal.

Grooves can also be cut using a milling machine.

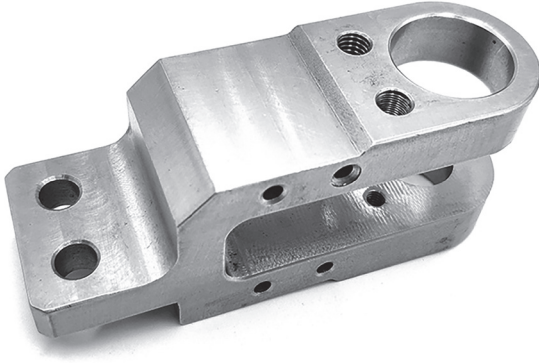
Give **two** advantages of using a milling machine rather than a manual process.

1
.....
2
..... [2]

5 Computer Numerical Control (CNC) machines can be used to manufacture a wide variety of products.

(a) The item shown in **Fig. 5** was manufactured from a single piece of aluminium.

Fig. 5



(i) Name **one** CNC machine that would be suitable to manufacture the item shown in **Fig. 5**.

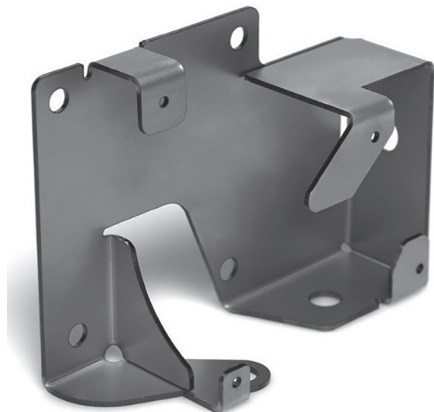
..... [1]

(ii) State how it is possible to produce many different shaped aluminium products using the same CNC machine.

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

(b) **Fig. 6** shows an item manufactured from sheet aluminium.

Fig. 6



(i) Name **one** CNC machine that could be used to produce the bends in the sheet.

..... [1]

(ii) State how it is possible for this machine to produce different shaped bends.

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

(iii) Give **two** reasons why the manufacturer would choose to produce the holes by CNC punching instead of CNC laser cutting.

1

2

[2]

(c) Fig. 7 shows a connector manufactured from hexagonal aluminium stock.

Fig. 7



Name **one** CNC process that can be used to manufacture this item.

..... [1]

(d) Fig. 8 shows a gear assembly which was made from several pieces of metal joined together by laser welding.

Fig. 8



Explain why parts of small items such as this can be joined by CNC laser welding but not by conventional welding.

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

6 (a) State **two** ways that modern technology can improve engineering production.

1

.....

2

.....

[2]

(b) Describe **one** benefit of global manufacturing.

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..... [2]

(c)* Discuss the statement; 'Automation using modern technologies changes the workforce and the types of job that are carried out in an engineering company'.

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..... [6]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

A large area of lined paper for writing, consisting of 25 horizontal dotted lines. A solid vertical line runs down the left side of the page, creating a margin. The rest of the page is open for writing.

This block contains a vertical solid line on the left side of the page, approximately one-tenth of the way from the left edge. From this line, horizontal dotted lines extend across the entire width of the page. There are 24 such dotted lines, evenly spaced, creating a series of horizontal writing bands. The page is otherwise blank.

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