GCSE
ENGINEERING

Unit 1 Written Paper

Time allowed: 2 hours

Materials
For this paper you must have:
- normal writing and drawing instruments
- a calculator.

Instructions
- Use black ink or black ball-point pen. Use pencil only for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Some questions will require you to shade a circle. If you make a mistake cross through the incorrect answer.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 120.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

Do not write outside the box

Answer **all** questions in the spaces provided.

For each question completely fill in the circle alongside the appropriate answer.

CORRECT METHOD ●   WRONG METHODS ⊗ ⊙ ⬤ ⍉

If you want to change your answer you must cross out your original answer as shown. ⊠

If you wish to return to an answer previously crossed out, ring the answer you now wish to select as shown. ⊗

| 0 | 1 | . | 1 | Which of the following describes an alloy?

[1 mark]

A A liquid metal ⬭

B A mixture including metallic materials ⬭

C A mixture of non-metallic materials ⬭

D A pure metal ⬭

| 0 | 1 | . | 2 | Which heat treatment process for steel involves heating to high temperatures then cooling rapidly in water?

[1 mark]

A Annealing ⬭

B Galvanising ⬭

C Hardening ⬭

D Normalising ⬭

Do not write outside the box

0 1 . 3 Which of the following is a thermosetting polymer?

[1 mark]

A Acrylic ⬯

B Nylon ⬯

C Polypropylene ⬯

D Polyurethane ⬯

0 1 . 4 Which of the following is a pushing force that moves an object forwards through the air?

[1 mark]

A Drag ⬯

B Friction ⬯

C Lift ⬯

D Thrust ⬯

0 1 . 5 Which one of the following properties allows a material to resist bending?

[1 mark]

A Brittleness ⬯

B Hardness ⬯

C Stiffness ⬯

D Toughness ⬯

Turn over ▶

IB/G/Jun22/8852/W

| 0 | 1 | . | 6 | Which of the following is an output component?

[1 mark]

A Light dependent resistor ⬭

B Light emitting diode ⬭

C Thermistor ⬭

D Timer ⬭

| 0 | 1 | . | 7 | Name the component shown in **Figure 1**.

[1 mark]

Figure 1
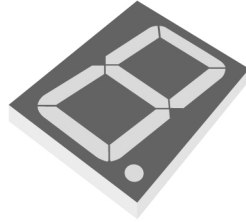
A Capacitor ⬭

B Microcontroller ⬭

C 7 Segment Display ⬭

D Transistor ⬭

0 1 . 8 Complete the following statements using the word bank provided.

Composites are materials made by _____ two or more different materials.

They can have _____ that are not possible with individual materials.

A disadvantage of composites is that they are difficult to separate and cannot be easily _____ .

Word bank

colours, combining, joined, layering, properties, recycled, shaping, substituted, textures

[3 marks]

10

Turn over for the next question

Turn over ▶

0 2 . 1 Stainless steel pans are shown in **Figure 2**.

Figure 2

Give **three** reasons why stainless steel is a suitable material for the pans.

[3 marks]

Reason 1 _____
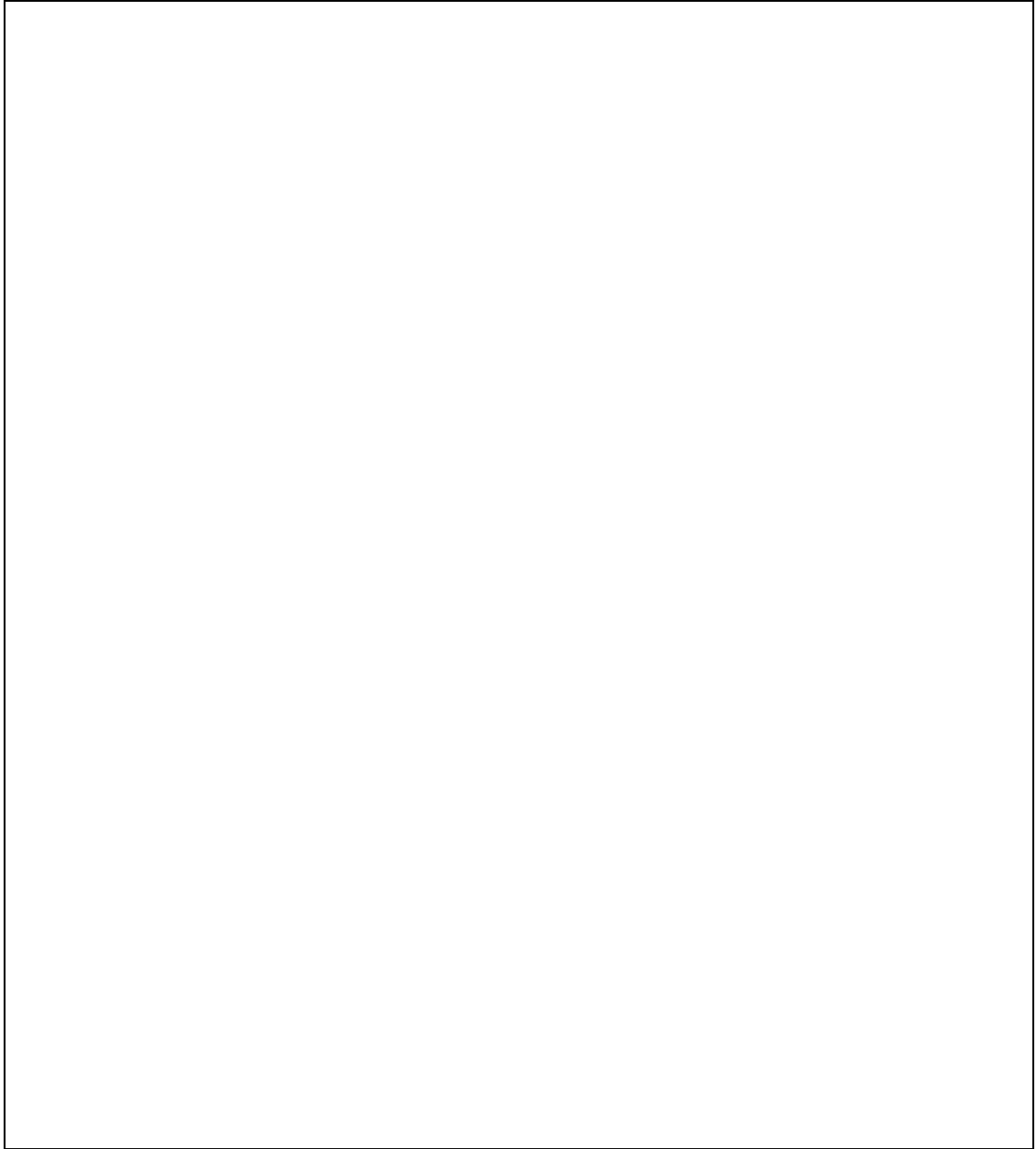
_____

Reason 2 _____

_____

Reason 3 _____

_____

0 2 . 2 Use notes and sketches to explain how two metal parts can be fastened together using riveting.

[4 marks]

Turn over ▶

0 2 . 3 A drilling machine is shown in **Figure 3**.

Figure 3

Evaluate **two** risks of using this machine.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

0 2 . 4 Inside the drilling machine there is a simple gear train.

The driver gear has 85 teeth and the driven gear has 152 teeth.

Calculate the gear ratio.

Show your working.

Give your answer to **two** decimal places.

[3 marks]

Answer

0 2 . 5 The speed of the drilling machine motor is 1430 rpm.

Calculate the output speed.

Show your working.

Formula:

$$\frac{\text{Speed driver gear}}{\text{Speed driven gear}} = \frac{\text{Number of teeth on driven gear}}{\text{Number of teeth on driver gear}}$$

[2 marks]

Answer _____ rpm

Turn over ▶

0 2 . 6 Identify **one** difference between drilling using a pillar drill and drilling using a lathe.
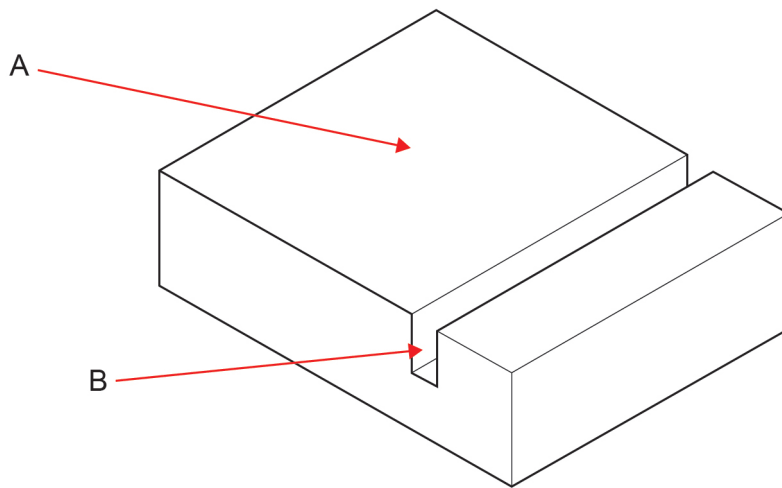
[2 marks]

0 2 . 7 **Figure 4** shows a block of material.

Figure 4

A

B

Name the machining processes used to create the flat surface shown at A and the groove shown at B.

[2 marks]

Flat surface A process

Groove B process

20

0 3   Two bridges made from different materials are shown in **Figure 5** and **Figure 6**.

| **Figure 5** | **Figure 6** |

          Structural concrete   **Structural timber**

Analyse the suitability of the **two** materials for constructing a bridge in terms of the following:

[6 marks]

Properties _____

_____

_____

_____

Advantages _____

_____

_____

_____

Disadvantages _____

_____

_____

_____

6

Turn over ▶

0 4 . 1 **Figure 7** shows a greenhouse manufactured using standard forms of material.

Figure 7

The manufacturer is considering offering different sizes of greenhouse.

Analyse the manufacturing and cost implications of using standard forms compared to specially made.

[4 marks]

| 0 | 4 | . | 2 | **Table 1** shows material costs for a greenhouse.

Table 1

Material	Cost	Quantity
Aluminium frame	£1.72 per m	47
Polycarbonate panels	£3.06 per panel	32
Fastenings	£7.75 per pack	1

The greenhouse requires 1.5 hours of manufacturing time at £30 per hour.

Calculate the total cost of manufacturing the greenhouse.

Show your working.

[4 marks]

Answer £ _____

| 0 | 4 | . | 3 | The manufacturer estimates that the total cost of the greenhouse would be 37% higher if made from toughened glass panels.

Calculate the **total cost** of the greenhouse if toughened glass panels were used.

Show your working.

[2 marks]

Answer £ _____

Turn over ▶

0 4 . 4 Other than cost, evaluate which other factors engineers need to consider when selecting materials.

Give examples in your answer.

[6 marks]

| 0 | 4 | . | 5 | Name a suitable production process for shaping polystyrene.

Explain why that process is suitable.

[3 marks]

Process _____

Explanation _____

_____

_____

_____

| 0 | 4 | . | 6 | Explain the advantages of Fibre Reinforced Polymers (FRP).

[2 marks]

_____

_____

_____

_____

21

Turn over for the next question

Turn over ▶

0 5 A lathe is shown in **Figure 8**.

Figure 8

A   B
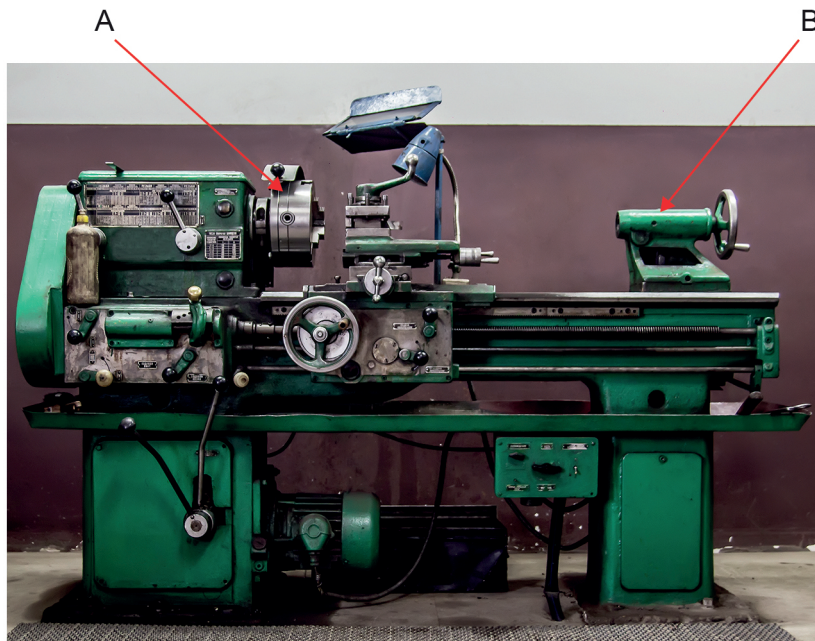
0 5 . 1 Identify the parts of the lathe at A and B.

[2 marks]

Part A _____

Part B _____

0 5 . 2 **Figure 9** shows a tool used on the lathe.

Figure 9

Name the tool in **Figure 9** and explain what it is used for.
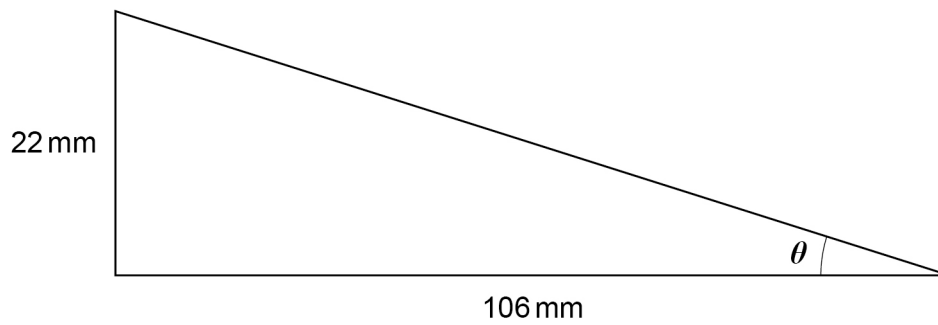
[2 marks]

Tool name _____

Used for _____

_____

0 5 . 3 A metal part will be taper turned.

Calculate the angle of the taper shown as θ on **Figure 10**.

Show your working.

[3 marks]
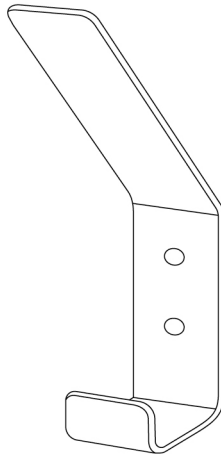
Figure 10

22 mm

106 mm

θ

Answer _____ degrees

Question 5 continues on the next page

0 5 . 4   An aluminium coat hook is shown in **Figure 11**.

Figure 11

Complete the table to create a production plan to manufacture the coat hook.

Some parts have been completed for you.

[6 marks]

Order	Process	Hand tools	Description of process
1	Mark out the coat hook shape.	Scriber, steel rule	Mark out the size of the coat hook and the position of the holes with a steel ruler and a scriber.
2	Cut out the shape.		
3	Make the holes.	Centre punch, drill	Centre punch the position of the holes. Clamp the work piece and drill through the material.
4	Refine the edges and holes.		
5	Bend to correct angle.		

0 5 . 5 A fixing hole in the coat hook is changed to the shape shown in **Figure 12**.

Figure 12
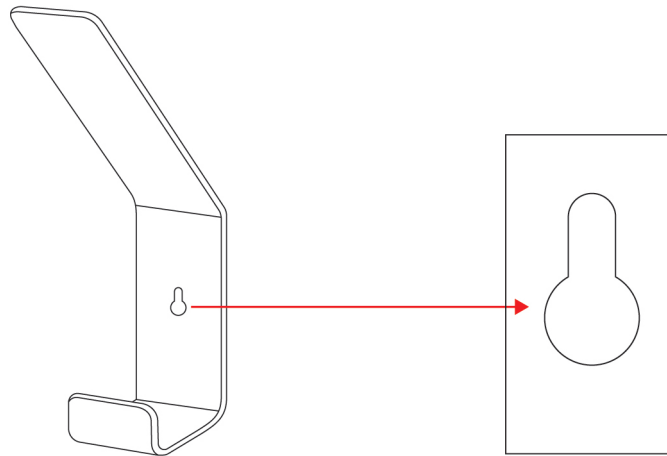
Name **two** machining processes that could be used to cut out the fixing hole shape.

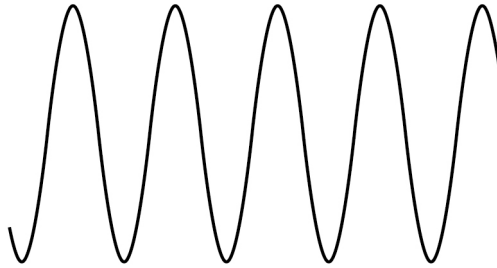**[2 marks]**

Process 1 _____

Process 2 _____

15

Turn over for the next question

Turn over ▶

0 6 . 1 A sine wave is shown in **Figure 13**.

Figure 13

Does the sine wave represent an analogue or digital signal?

[1 mark]

_____

0 6 . 2 Name **one** benefit of using a piezo sounder rather than a buzzer in a circuit.

[1 mark]

_____

_____

0 6 . 3 Describe how an engineer would predict performance in an electronic circuit.

[2 marks]

_____

_____

_____

_____

0 6 . 4 A circuit for a light emitting diode (LED) contains a 250 Ω resistor and the voltage is 6 V.

Calculate the current flowing through the circuit.

Use the formula V = I × R

Give your answer to **three** decimal places.

[4 marks]

Answer with unit _____

0 6 . 5 Explain why a resistor is required in the LED circuit.

[2 marks]

0 6 . 6 Give **one** example of when an Analogue to Digital Conversion (ADC) is used.

[2 marks]

Turn over ▶

0 6 . 7 A system is designed to operate a motorised window blind.

The system consists of a motor, light sensor, a microcontroller and a Field Effect Transistor (FET).

In the space below, draw a systems diagram to show the operation of the motorised window blind.

[6 marks]

0 6 . 8 Analyse the use of a motorised window blind system rather than a manually operated one.

[2 marks]

20

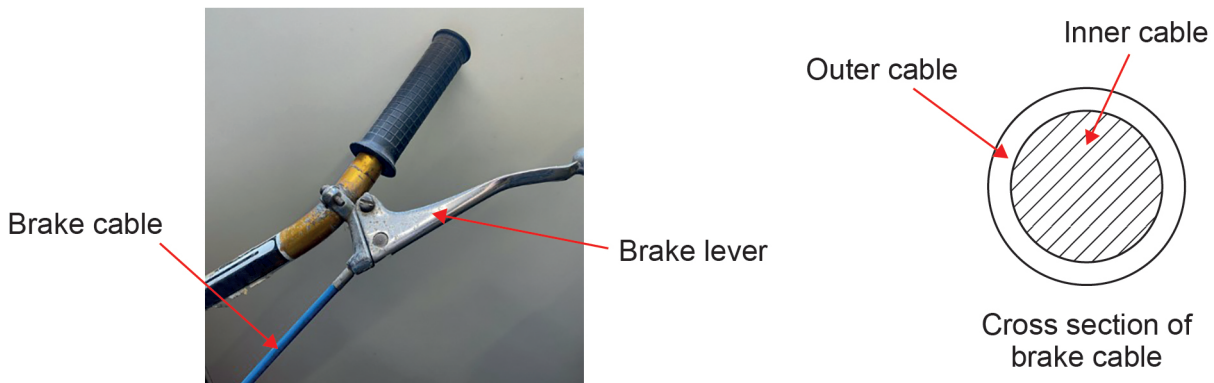**0 7 . 1** Name **one** non-renewable form of energy production.

[1 mark]

_____

_____

_____

0 7 . 2 Tidal energy and wind energy are two methods of renewable energy production.

Compare the use of the two energy methods.

Discuss the following aspects in your answer:

- advantages and disadvantages
- impact on the environment.

[8 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

9

Turn over ▶

0 8 . 1 **Figure 14** shows a brake lever and cable.

Figure 14

Brake cable

Brake lever

Outer cable

Inner cable

Cross section of brake cable

The inner cable has a diameter of 1.6 mm. The force applied by the lever is 70 N.

Calculate the stress applied to the inner cable when the lever is pulled.

Formula: Stress = Force/Cross section area

Cross section area = πr^2

[3 marks]

Answer _____ N/mm^2

0 8 . 2 State which force is applied to the inner cable when the brake lever is pulled.
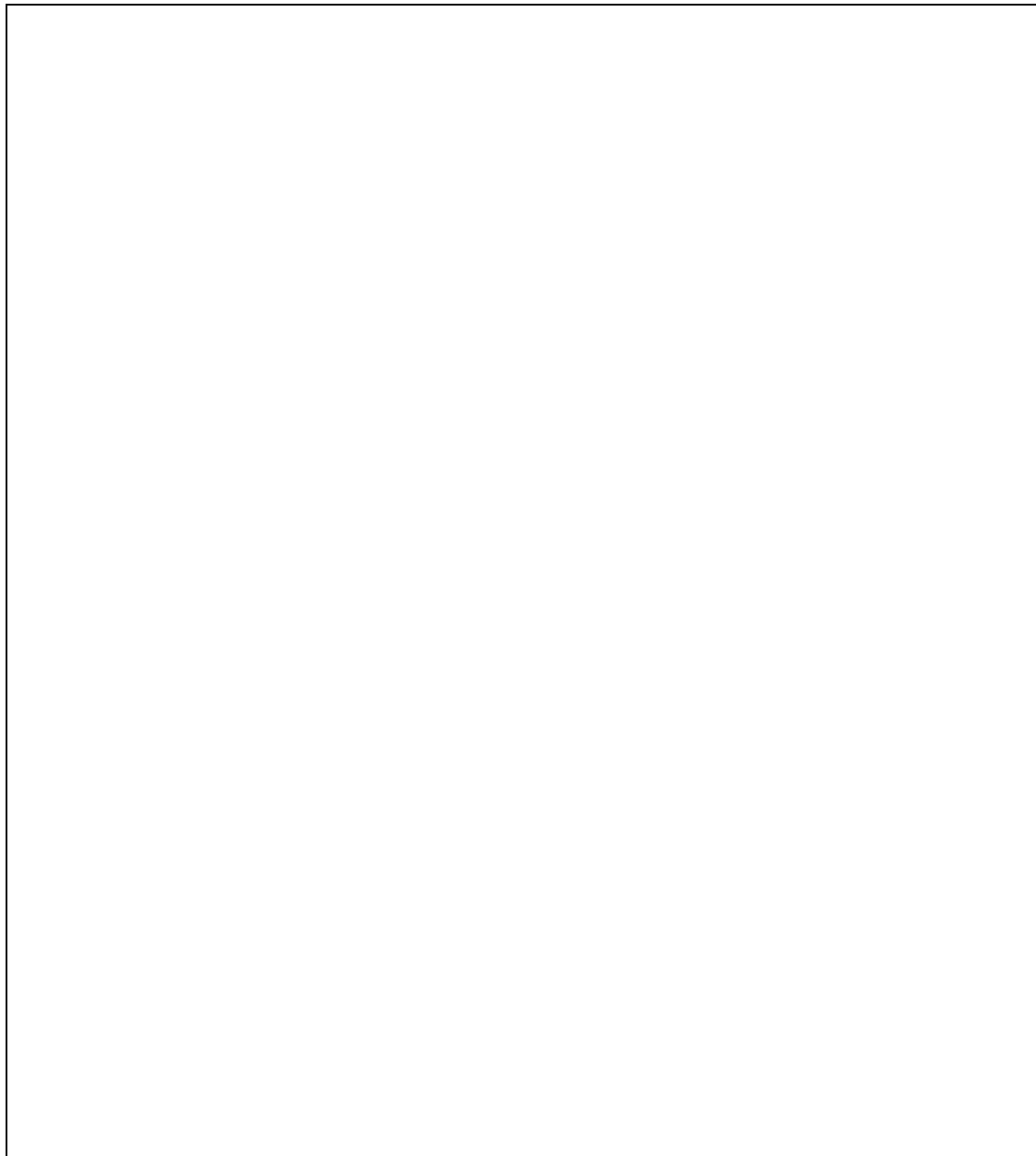
[1 mark]

0 8 . 3 The manufacturer must test the inner cable to determine how much it stretches.

Using notes and sketches, design a test that would assess this property of the inner cable.

[6 marks]

Question 8 continues on the next page

Turn over ▶

0 8 . 4 **Table 2** shows the results of testing when increasing force is applied to the inner cable.
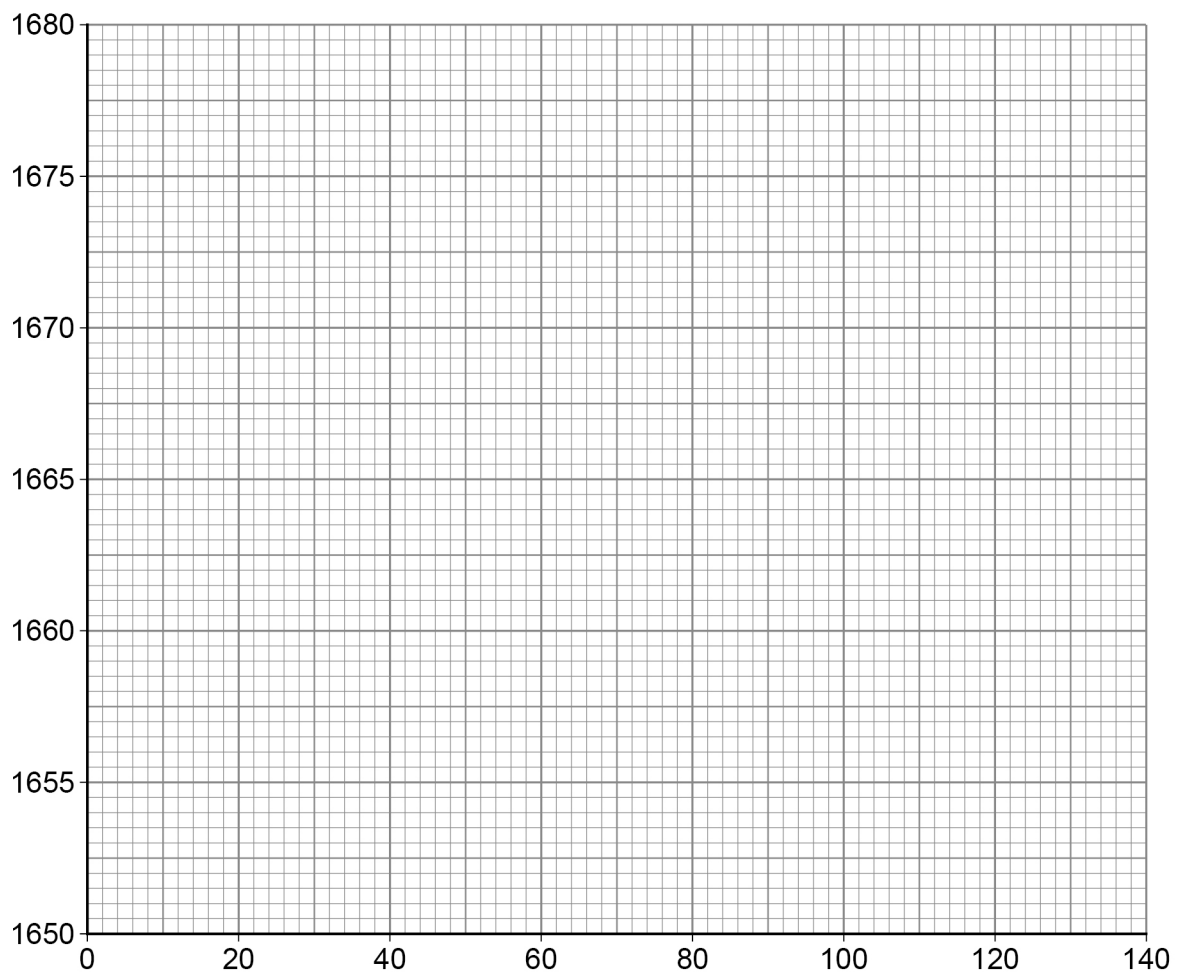
Table 2

Force in N	20	40	60	80	100	120
Length in mm	1650	1652	1655	1659	1664	1670

Using the data in **Table 2**, plot a graph to show the relationship between the force applied and the change in length.

Marks will be awarded for:

- labelling the axes
- plotting the data onto the graph
- drawing a line to connect the plotted data.

[4 marks]

0 8 . 5 Predict the length of the inner cable if a force of 110 N is applied.

[1 mark]

Answer _____ mm

0 8 . 6 State the material property that allows the inner cable to stretch when a force is applied.

[1 mark]

_____

_____

16

0 9 . 1 Name **one** example of a rapid prototyping process.

[1 mark]

_____

_____

0 9 . 2 Give **two** advantages of using a rapid prototyping process.

[2 marks]

Advantage 1 _____

_____

Advantage 2 _____

_____

3

END OF QUESTIONS

There are no questions printed on this page

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

Question number	Additional page, if required. Write the question numbers in the left-hand margin.

Question number	Additional page, if required. Write the question numbers in the left-hand margin.

Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

There are no questions printed on this page

Do not write
outside the
box

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED