GCSE
ENGINEERING

Unit 1 Written Paper

Wednesday 12 June 2024   Morning   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	

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 process used for steel involves heating then allowing the steel to cool naturally?

[1 mark]

     A Annealing   ⬭

     B Galvanising   ⬭

     C Hardening   ⬭

     D Normalising   ⬭

0 1 . 2   Which of the following is an interfacing device?

[1 mark]

     A Capacitor   ⬭

     B Light Dependent Resistor   ⬭

     C Light Emitting Diode   ⬭

     D Transistor   ⬭

0 1 . 3 Which of the following forces keeps an aeroplane in the air?

[1 mark]

A Drag ⬭

B Friction ⬭

C Lift ⬭

D Thrust ⬭

0 1 . 4 Which is the correct formula for calculating Young's modulus (E)?

[1 mark]

A Young's modulus = area/pressure ⬭

B Young's modulus = pressure/area ⬭

C Young's modulus = strain/stress ⬭

D Young's modulus = stress/strain ⬭

0 1 . 5 Which **two** of the following are thermoplastics?

[2 marks]

A Epoxy ⬭

B Nylon ⬭

C Polycarbonate ⬭

D Polyester resin ⬭

E Polyurethane ⬭

F Vulcanised rubber ⬭

Question 1 continues on the next page

Turn over ▶

0 1 . 6 Use the word bank provided to complete the following statements.

Brass consists of two or more different metals which means it is _____ .

The two main metals are _____ and _____ .

Brass is non-ferrous because it does not contain _____ .

Word bank
a ceramic
a composite
aluminium
an alloy
bronze
carbon fibre
copper
gold
iron
lead
nickel
zinc

[4 marks]

10

0 2 . 1 Sintering is a process used to produce metal components.

Explain the sintering process.

[2 marks]

_____

_____

_____

_____

_____

0 2 . 2 There are many different forms of manufactured board.

Identify **two** differences between Medium Density Fibreboard (MDF) and Oriented Strand Board (OSB).

[2 marks]

Difference 1 _____

_____

Difference 2 _____

_____

0 2 . 3 Identify **two** differences between hard soldering and soft soldering.

[2 marks]

Difference 1 _____

_____

Difference 2 _____

_____

0 2 . 4 State **two** differences between thermosetting polymers and thermoplastic polymers.

[2 marks]

Difference 1 _____

_____

Difference 2 _____

_____

8

Turn over ▶

0 3 . 1 Analyse why most cars are built with a monocoque structure.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

0 3 . 2 Material testing is often used to make sure a material is suitable for a particular purpose.

Name **one** non-destructive test and **one** destructive test.

[2 marks]

Non-destructive test _____

_____

Destructive test _____

_____

0 3 . 3 Analyse **one** benefit of using a non-destructive testing method compared to a destructive testing method.

[3 marks]

_____

_____

_____

_____

_____

_____

0 3 . 4 Explain how altering the amount of carbon content changes the properties of steel.

[2 marks]

_____

_____

_____

_____

0 3 . 5 Give **one** use of high carbon steel.

[1 mark]

_____

_____

0 3 . 6 State **one** routine maintenance check that should be carried out on a drilling machine.

[1 mark]

_____

_____

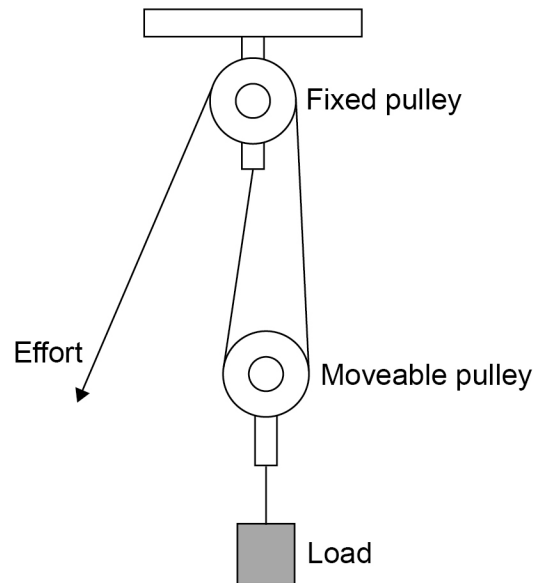**0 3 . 7** Explain the importance of carrying out routine maintenance checks.

[2 marks]

_____

_____

_____

_____

15

Turn over for the next question

Turn over ▶

0 4 . 1 **Figure 1** shows a pulley system that is being used to lift a heavy load.

Figure 1

Analyse the benefits of using a pulley system for lifting heavy loads.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

0 4 . 2 The mechanical advantage (MA) of a pulley system is 3.

Calculate how much effort is needed to lift a load of 240 N.

Use the formula MA = load/effort

Show your working.

[3 marks]

Answer _____ N

0 4 . 3 The pulleys are made from aluminium using the sand-casting process.

Identify any **two** stages in the sand-casting process.

[2 marks]

$\dfrac{\quad}{9}$

Turn over for the next question

Turn over ▶

0 5 In a factory, any item that is not the correct mass must be identified and removed from a production line that is working **continuously**.

A microcontroller uses a sensor to weigh each item and a lever is used to remove the item if it is not the correct mass.
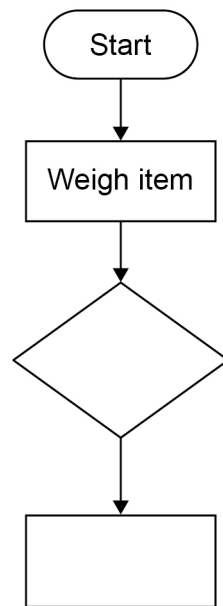
0 5 . 1 Complete the systems block diagram by adding the missing terms at the **three** points: **A**, **B** and **C**.

[3 marks]

INPUT   A _____   B _____
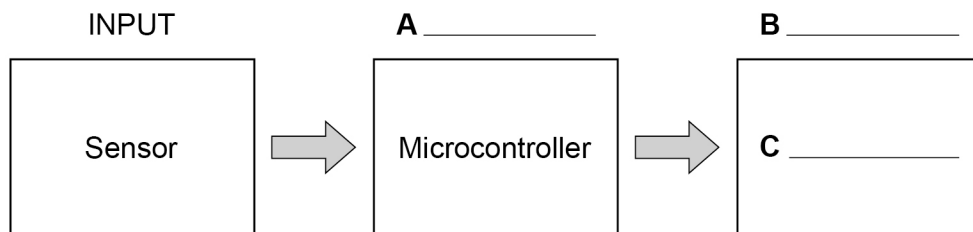
| Sensor | Microcontroller | C _____ |

| 0 | 5 | . | 2 | Complete the flowchart so that the production line system will operate correctly.

[4 marks]

```
                    ⬭ Start ⬭
                        │
                        ▼
                ┌───────────────┐
                │  Weigh item   │
                └───────────────┘
                        │
                        ▼
                      ◇   ◇
                   ◇         ◇
                      ◇   ◇
                        │
                        ▼
                ┌───────────────┐
                │               │
                │               │
                └───────────────┘
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Question 5 continues on the next page

Turn over ▶

0 5 . 3 The lever to remove the item from the production line could be pneumatically or hydraulically operated.

Evaluate the advantages and disadvantages of using pneumatic operation rather than hydraulic operation for the lever.

[6 marks]

13

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0 6   A student wants to make a simple rectangular aluminium box as shown in **Figure 2**.

Figure 2

Material: 2 mm thick aluminium sheet
All dimensions in millimetres
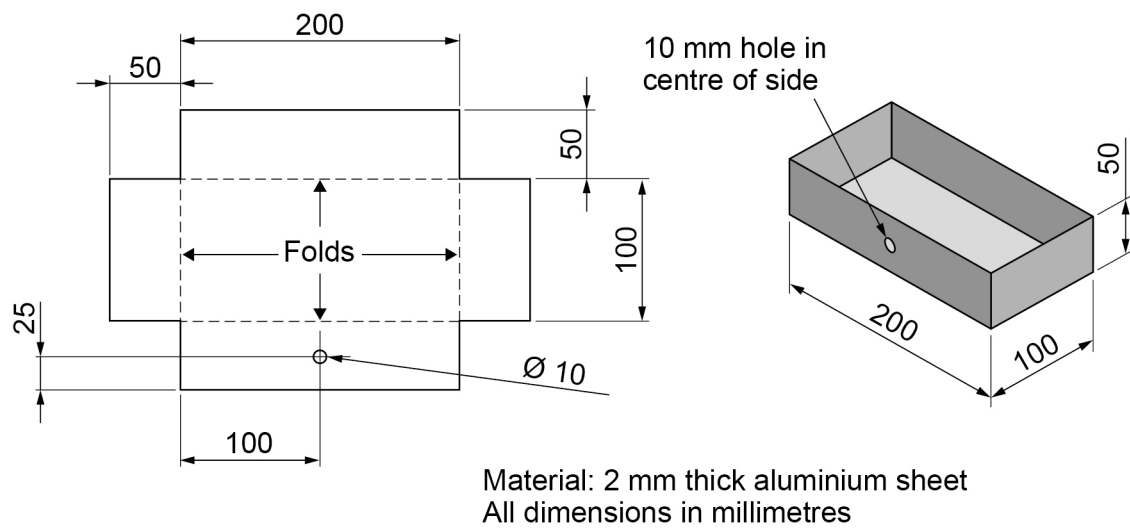
The 10 mm hole is drilled into the 2 mm thick aluminium sheet using a drilling machine. The sheet is then cut and folded into shape.

0 6 . 1 Using notes and/or sketches, explain how the student could secure the aluminium sheet and drill the 10 mm hole using a drilling machine.

Include all safety precautions.

[6 marks]

Turn over ►

0 6 . 2 After drilling, the corners, shown shaded in **Figure 3**, are removed.

Figure 3

50

50

All dimensions
in millimetres
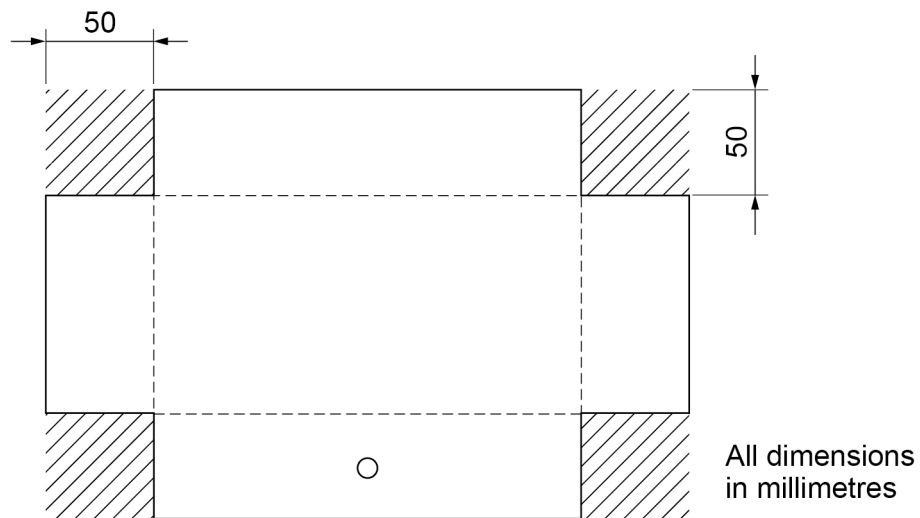
Figure 4 shows a tool suitable for removing the corners.

Figure 4
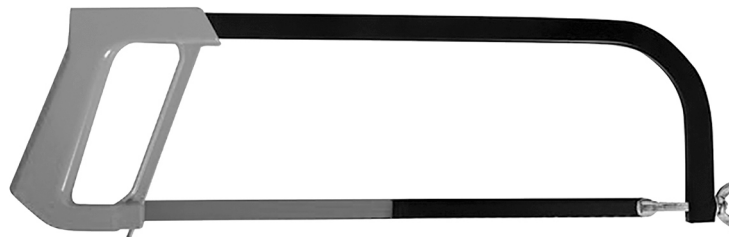
Name the tool shown in **Figure 4**.

[1 mark]

0 6 . 3 Evaluate why the tool shown in **Figure 4** is suitable for removing the corners as shown in **Figure 3**.

[3 marks]

Question 6 continues on the next page

Turn over ▶

Figure 2 is repeated below.

Figure 2

200

50

10 mm hole in centre of side

50

100

25

Folds

100

Ø 10

50

200

100
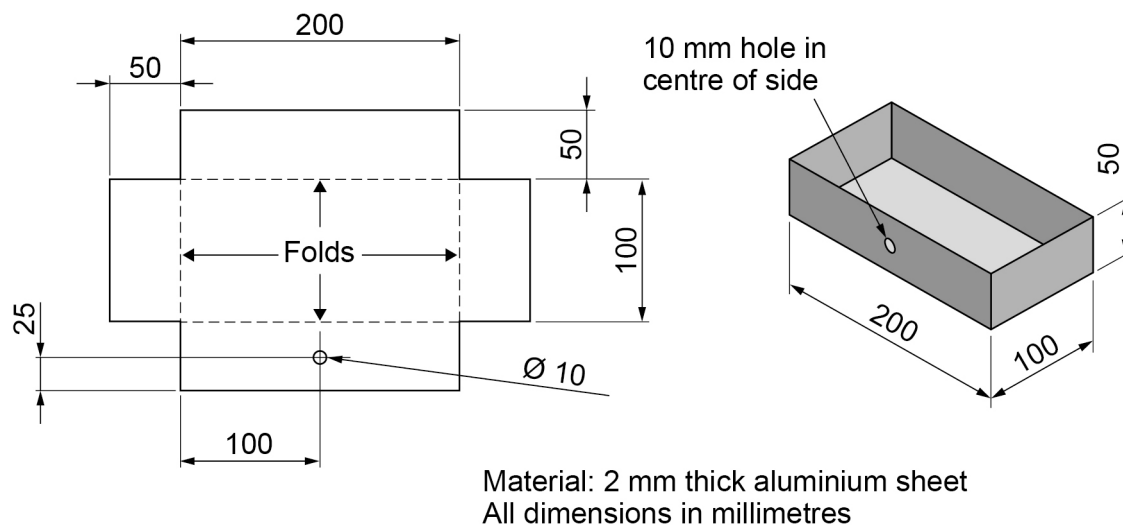
Material: 2 mm thick aluminium sheet
All dimensions in millimetres

| 0 | 6 | . | 4 | Explain how to accurately produce the folds for the box shown in **Figure 2**. Include information on tools, processes and quality checks.

[5 marks]

Figure 3 is repeated below.

Figure 3

All dimensions in millimetres
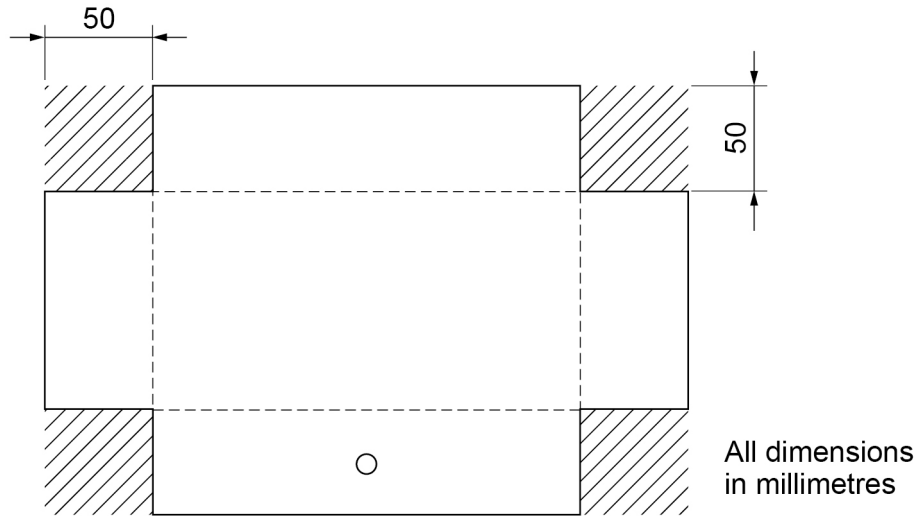
0 6 . 5   Calculate the **total** area of the material removed (corners) as shown in **Figure 3**.

Use the formula Area of a rectangle = length × width

Show your working.

[3 marks]

_____

_____

_____

_____

_____

_____

Answer _____ mm^2

Question 6 continues on the next page

Turn over ▶

0 6 . 6 The student wants to make a lid for the aluminium box using a similar method.

The total waste area for the lid is 2500 mm^2

The area of the original piece of aluminium is 37 500 mm^2

Calculate the percentage of material that is removed as waste.

Use the formula % waste $= \dfrac{\text{waste area}}{\text{original area}} \times 100$

Show your working.

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

[3 marks]

Answer _____ %

21

0 7 . 1 Name **one** fossil fuel used for energy production.

[1 mark]

_____

_____

_____

0 7 . 2 Biomass and wind energy are used in energy production.

Compare the advantages and disadvantages of these two energy production methods.

Discuss the following aspects in your answer:

- technologies used
- impact on society.

[8 marks]

_____

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9

Turn over ▶

0 8 **Figure 5** shows an electronic system that monitors how many cars enter a car park.

The way the system operates is stated below:

- when a car enters, the driver pushes a button
- this adds 1 to a microcontroller working as a counter
- the number of cars entering the car park is shown by an LED display.

Figure 5

ENTRANCE

Car enters
Button is pressed which changes the LED display

Microcontroller counter

LED display
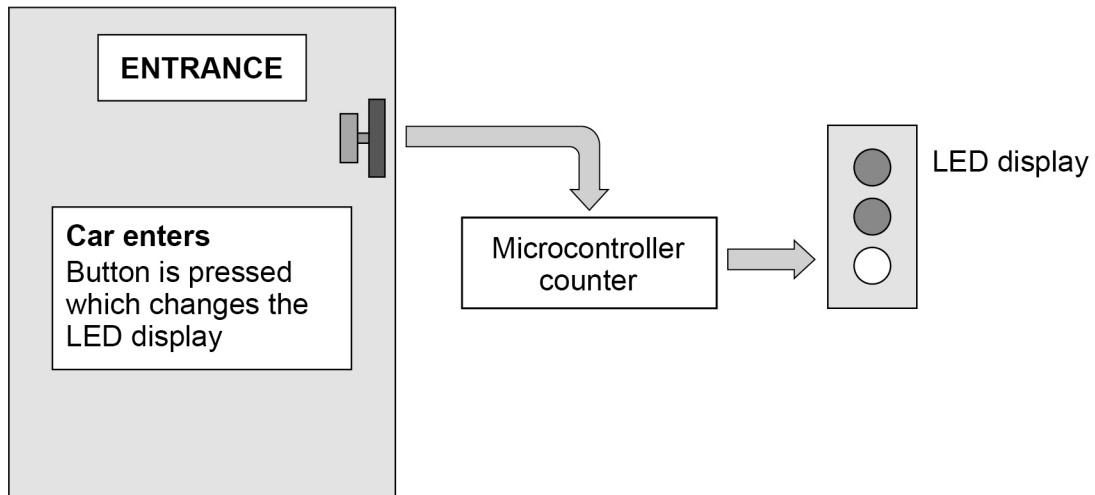
0 8 . 1 Analyse why a microcontroller has been used instead of a discrete device for this system.

[3 marks]

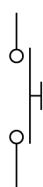**0 8 . 2** Complete the schematic drawing in **Figure 6** by correctly connecting the:

- battery to the power
- battery to ground
- switch to clock/input
- switch to power
- LEDs to outputs
- resistor R2 with the LEDs.

[6 marks]

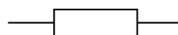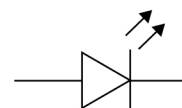**Figure 6**

Power

Clock

Input

Counter

Outputs

5 V

+

R1

Ground

R2
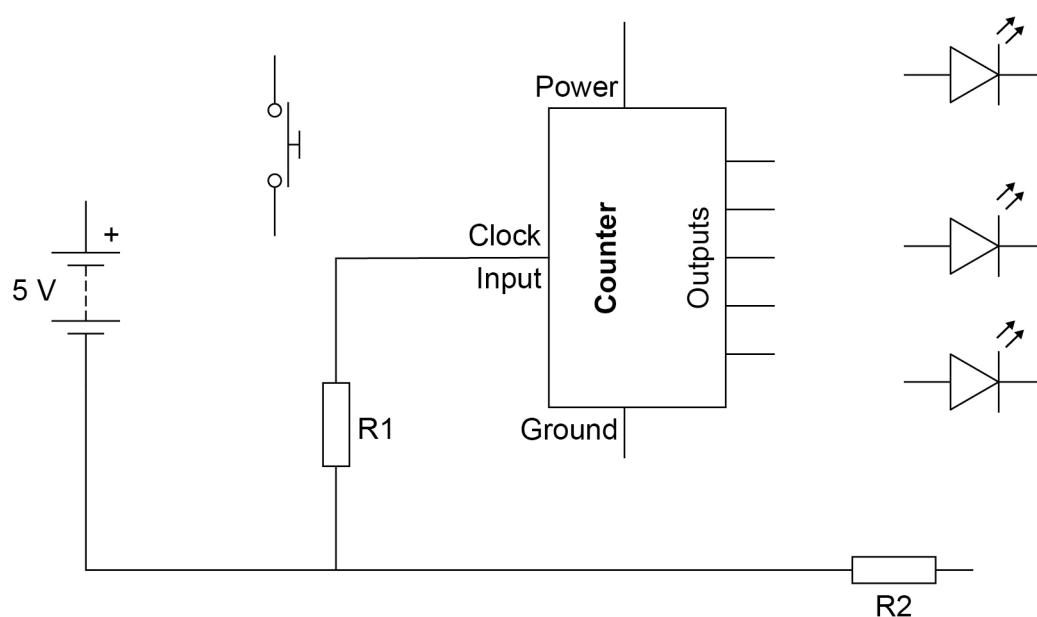
Names of symbols shown above

5 V

+
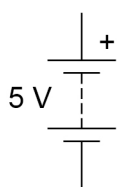
Battery

Switch

Resistor

LED

Turn over ▶

24

Figure 7 shows a simple circuit connecting an LED to a battery.

Figure 7

Current 0.02 A

Resistor

9 volt battery

Red LED
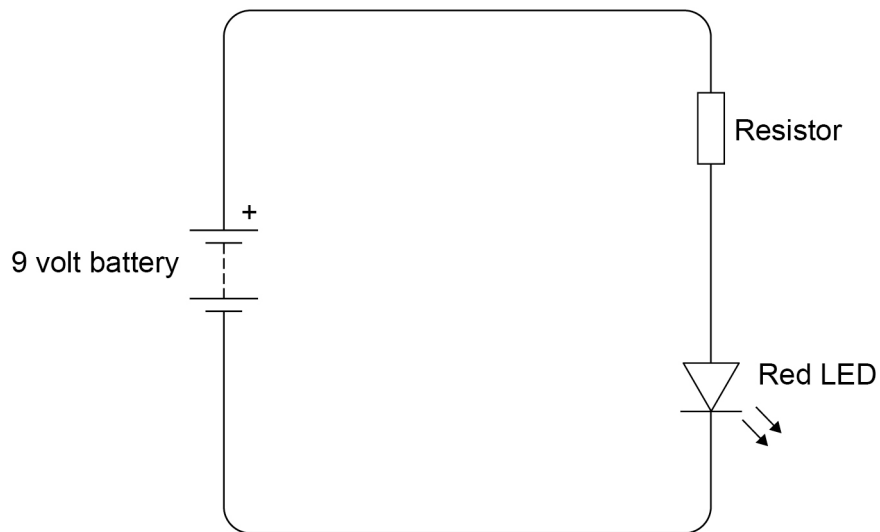
08.3 What is the function of the resistor?

[1 mark]

08.4 Calculate the size of the resistor required.

Use the formula V = IR

Show your working.

[3 marks]

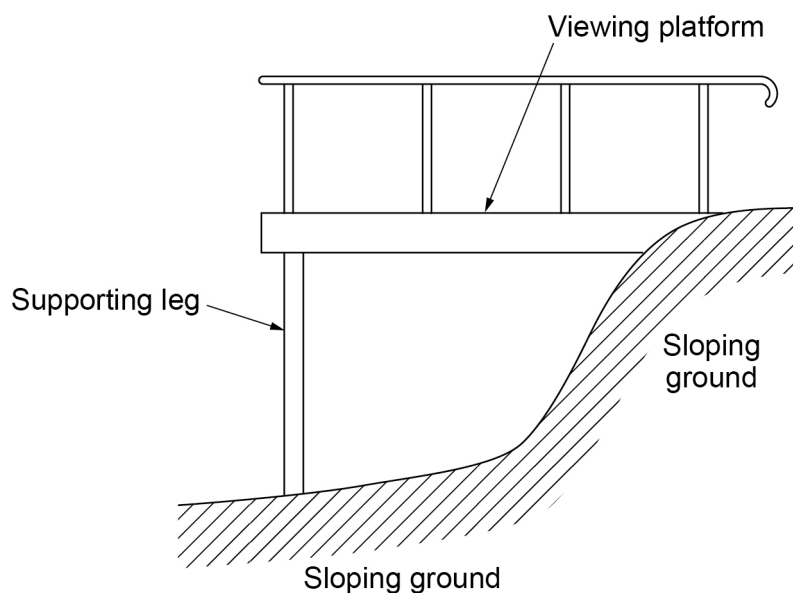Answer _____ ohms

13

IB/G/Jun24/8852/W

0	9

Figure 8 shows the design for a viewing platform.

It will be fastened to sloping ground at the rear and supported at the front by two legs made from low carbon steel tube.

Figure 8

0	9	.	1

Each supporting leg will need to support 2500 N.

The maximum allowed stress of the low carbon steel is 120 N/mm^2

Calculate the minimum cross-sectional area (csa) of **one** supporting leg.

Use the formula Stress = force/csa

Show your working.

[3 marks]

Answer _____ mm^2

Turn over ▶

0 9 . 2 The design of the viewing platform means that there is a risk that the supporting legs may buckle.

Explain what is meant by buckling.

[2 marks]

| 0 | 9 | . | 3 |

A cross-sectional view of a supporting leg is shown in **Figure 9** below.

The leg is made from a 100 mm external diameter tube that is 1.5 m long (L) and has a wall thickness of 5 mm.

Figure 9

100 mm external diameter tube

Wall thickness 5 mm

Calculate the volume of the low carbon steel used in **one** supporting leg.

Use the formula Volume of a cylinder = $\pi \times R^2 \times L$

Show your working.

Give your answer in mm³

[6 marks]

Answer _____ mm³

Turn over ▶

IB/G/Jun24/8852/W

0 9 . 4 The volume of the low carbon steel used in the platform is 0.11 m^3

Calculate the mass of the platform given that the density of the steel is 7750 kg/m^2

Use the formula Density = mass/volume

Show your working.

State the units of your answer.

[3 marks]

Answer _____ Unit _____

0 9 . 5 The supporting legs will be galvanised.

State the reason why low carbon steel is galvanised.

[1 mark]

0 9 . 6 Describe the galvanising process.

[3 marks]

0 9 . 7 Analyse the difference between a static load and a dynamic load.

In your answer, give **one** example of a static load and **one** example of a dynamic load.

[4 marks]

_____

_____

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_____

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_____

22

END OF QUESTIONS

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