

Please write clearly, in block capitals.

Centre number

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# GCSE ENGINEERING

Written Paper 8852/W

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Date of Exam


Morning

Time allowed: 2 hours

## Materials

For this paper you may use a calculator.

## Instructions

- Use black ink or black ball point pen. Use pencil only for drawing.
- Answer **all** questions.
- You must answer the questions in the spaces provided.
- Some questions will require you to shade a lozenge. If you make a mistake cross through the incorrect answer. 
- Do all rough work in this book. Cross through any work that 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.
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**0 1**

The following questions are about materials, their properties and how they can be used to make a range of engineering products.

**0 1****. 1**

The list below shows a range of different metals. Shade the lozenge next to the **three** metals which are **Non-Ferrous**.

**[3 marks]**

**A** Cast Iron

**B** Aluminium

**C** Copper

**D** Stainless Steel

**E** Bronze

**F** Low Carbon Steel

**0 1****. 2**

Which **one** of the following properties allows copper to be drawn into long wire without breaking?

**[1 mark]**

**A** Compressive strength

**B** Ductility

**C** Toughness

**D** Brittleness

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**0 1** . **3** Shade the correct lozenge to complete the sentence below.

Low Carbon Steel has a \_\_\_\_\_ strength to weight ratio than Carbon Fibre Reinforced Polymer.

**[1 mark]**

**A** Higher

**B** Lower

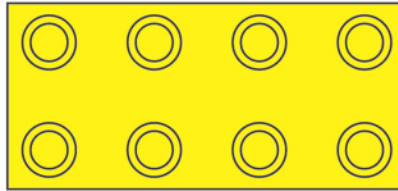
**C** Similar

**Turn over for the next question**

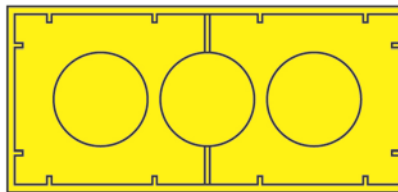
**0 1 . 4** A toy brick is shown in **Figure 1**.

**Figure 1**

Top view



Bottom view



Side view



What process would be used to manufacture this brick?

**[1 mark]**

**A** Vacuum forming

**B** Extrusion

**C** Injection moulding

**D** Blow moulding

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**0 1** . **5** Complete the following statement using the word bank provided.

Polymers are split into two categories. These are \_\_\_\_\_ and thermoplastic. Thermoplastics can be heated, which causes them to \_\_\_\_\_, allowing the material to be \_\_\_\_\_ into a range of products. An advantage of using thermoplastics is that products can be easily \_\_\_\_\_ when the product is finished with.

**Word bank**

harden, burn, cut, disposed of, soften, formed, thermosetting, recycled, thermosoftening

**[4 marks]**

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**0 2** . **1** Stainless Steel and Low Carbon Steel can be used to make kitchen equipment.

Compare the two materials and their suitability for this purpose in terms of the following.

**[6 marks]**

Differences

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Shared characteristics

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Ease of manufacture

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**0 2** . **2** A sheet of stainless steel is to be used in the manufacture of kitchen saucepans.

The sheet measures 3 metres by 2 metres and is 3 mm thick. Its density is given as 7.7 tonnes/m<sup>3</sup>.

Using the formula Mass = Density x Volume:

$$m = \rho \times v$$

calculate the mass of the stainless steel. Show your working.

Give your answer in kilograms (kg).

**[3 marks]**

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**0 2** . **3** The maximum mass that can safely be lifted by one person is 25 kg.

What is the minimum number of people that would be required to lift the sheet of stainless steel safely? Show your working.

**[2 marks]**

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**0 2** . **4** The steel sheet costs £2.80 per m<sup>2</sup>.

To make 1 pan, the manufacturer uses:

- 0.25 m<sup>2</sup> of stainless steel
- one handle
- two rivets.

The cost of materials is shown in **Table 1**.

**Table 1**

Item	Cost (each)
Stainless steel	£2.80 per m <sup>2</sup>
Handle	67p
Rivet	1.5p

Calculate the cost of each stainless steel pan. Show your working.

**[3 marks]**

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**0 2 . 5** A manufacturer needs to make 900 pans.

If the supplier of handles offers a 12% discount on orders of 1000 units what would be the most cost effective number of handles for the manufacturer to buy and what would the saving be?

**[3 marks]**

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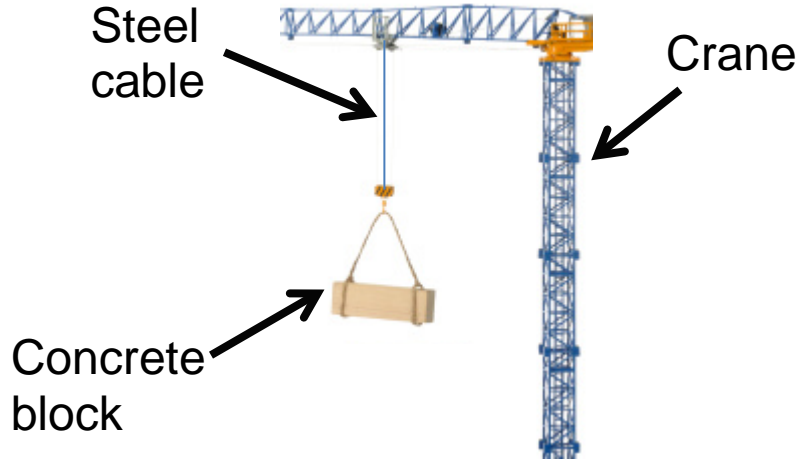
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0 3

Figure 2 shows a crane lifting a concrete block.

Figure 2



© iStock.com/Murat Sen

The crane uses a steel cable to lift the concrete block.

The cable is 10 metres long but stretches to 10.2 metres when the block is being lifted.

0 3 . 1

Calculate the strain in the cable. Show your working.

[4 marks]

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**0 3** . **3**

What is the mass, in kilograms, of the block in **Figure 2**? Show your working. You should assume a value for gravity of 9.81.

**[2 marks]**

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**0 3** . **4**

Young's modulus is used when designing engineered solutions to make sure a material is stiff enough for its intended purpose.

State the formula for Young's Modulus.

**[1 mark]**

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**Turn over for the next question**

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Questions 03.5 and 03.6 are about the design of a traffic control system using a bollard.

Study the photographs in **Figure 3** below. These show the operation of a bollard that allows access for buses.

**Figure 3**

**Showing bollard fully raised**



**Showing bollard fully lowered**



**0 3** . **5**

Analyse the bollard system in **Figure 3** and give two operating requirements for the bollard control system.

Explain the reason why each requirement is important.

Below is an example of how to answer.

Requirement: The bollard should remain in the raised position until the correct code is entered on a keypad, or a swipe card is presented.

Reason: To prevent unauthorised vehicles using the road.

**[4 marks]**

Requirement 1 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Reason 1 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Requirement 2 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Reason 2 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Turn over for the next question**

**0 3** . **6** The bollard is controlled by an electronic system mounted on a circuit board.

The designer has to choose between using **either** a dedicated board using timer, logic and counter integrated circuits **or** a microcontroller (PIC) based circuit board.

Evaluate these **two** alternatives giving reasons for the selection of the most suitable system.

**[3 marks]**

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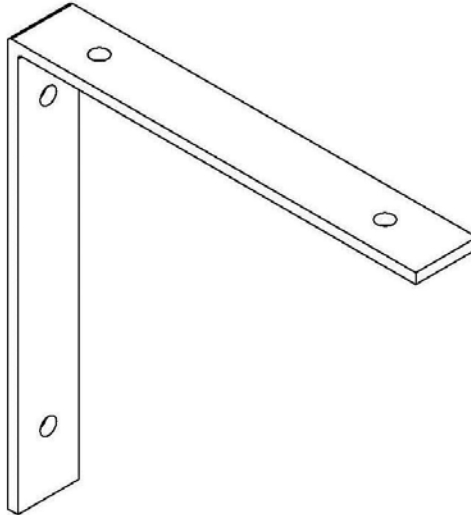
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0 4

Shelf brackets like the one shown in **Figure 4** are commonly used.

**Figure 4**



Identify a suitable material for a shelf bracket and explain why the material might be used.

**[3 marks]**

Material \_\_\_\_\_

Explanation \_\_\_\_\_

\_\_\_\_\_

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A range of engineered products are manufactured using composite materials.

Carbon fibre reinforced polymer is an increasingly popular material.

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Name **two** composite materials other than carbon fibre reinforced polymer.

**[2 marks]**

Composite 1 \_\_\_\_\_

Composite 2 \_\_\_\_\_

**Turn over for the next question**

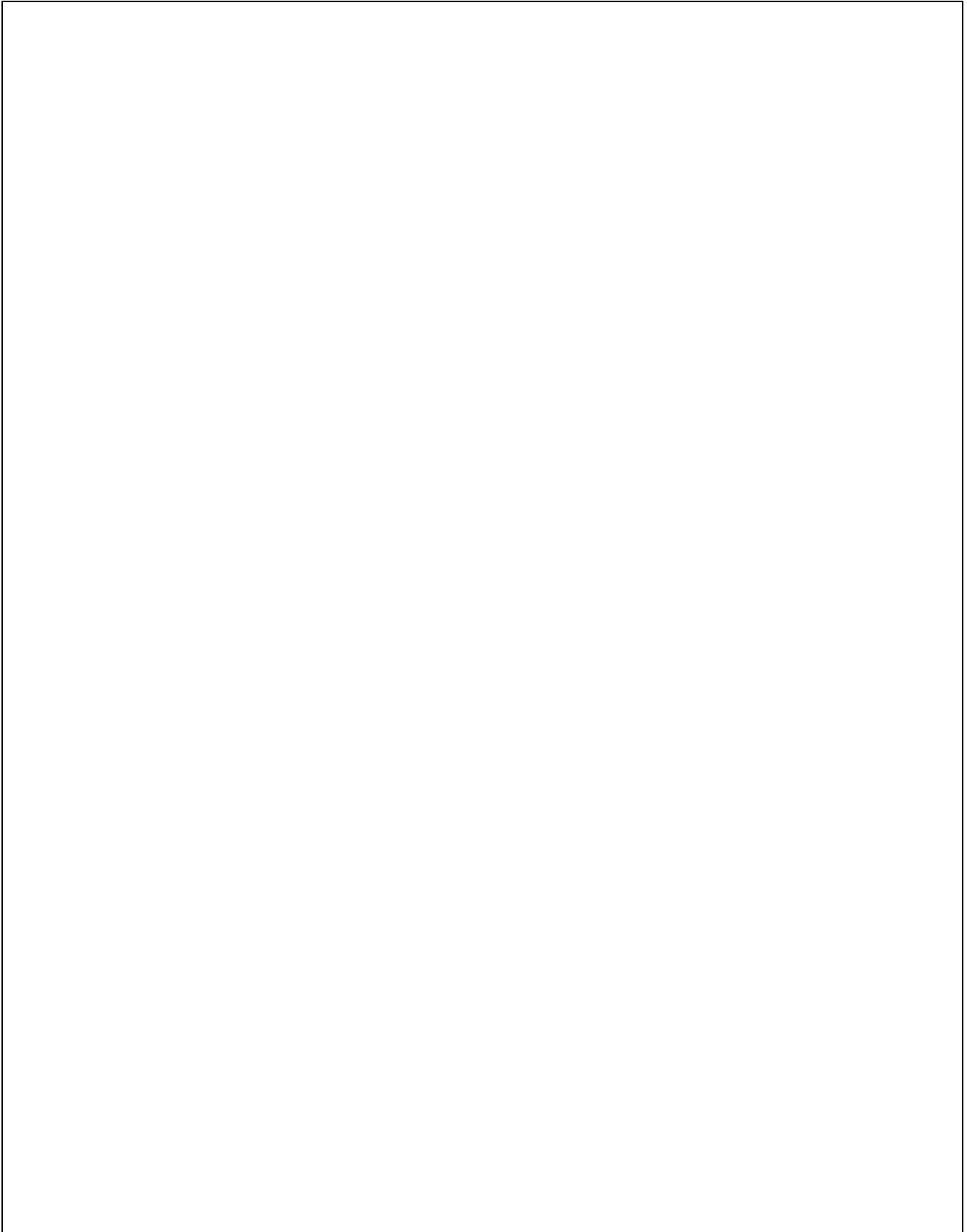
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Space for sketches for question **5.2**

A large, empty rectangular box with a thin black border, intended for drawing sketches related to question 5.2. The box occupies most of the page's vertical space below the header and above the footer.



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**0 5** . **4** Explain the term aerodynamic lift. You may use sketches in your answer.

**[2 marks]**

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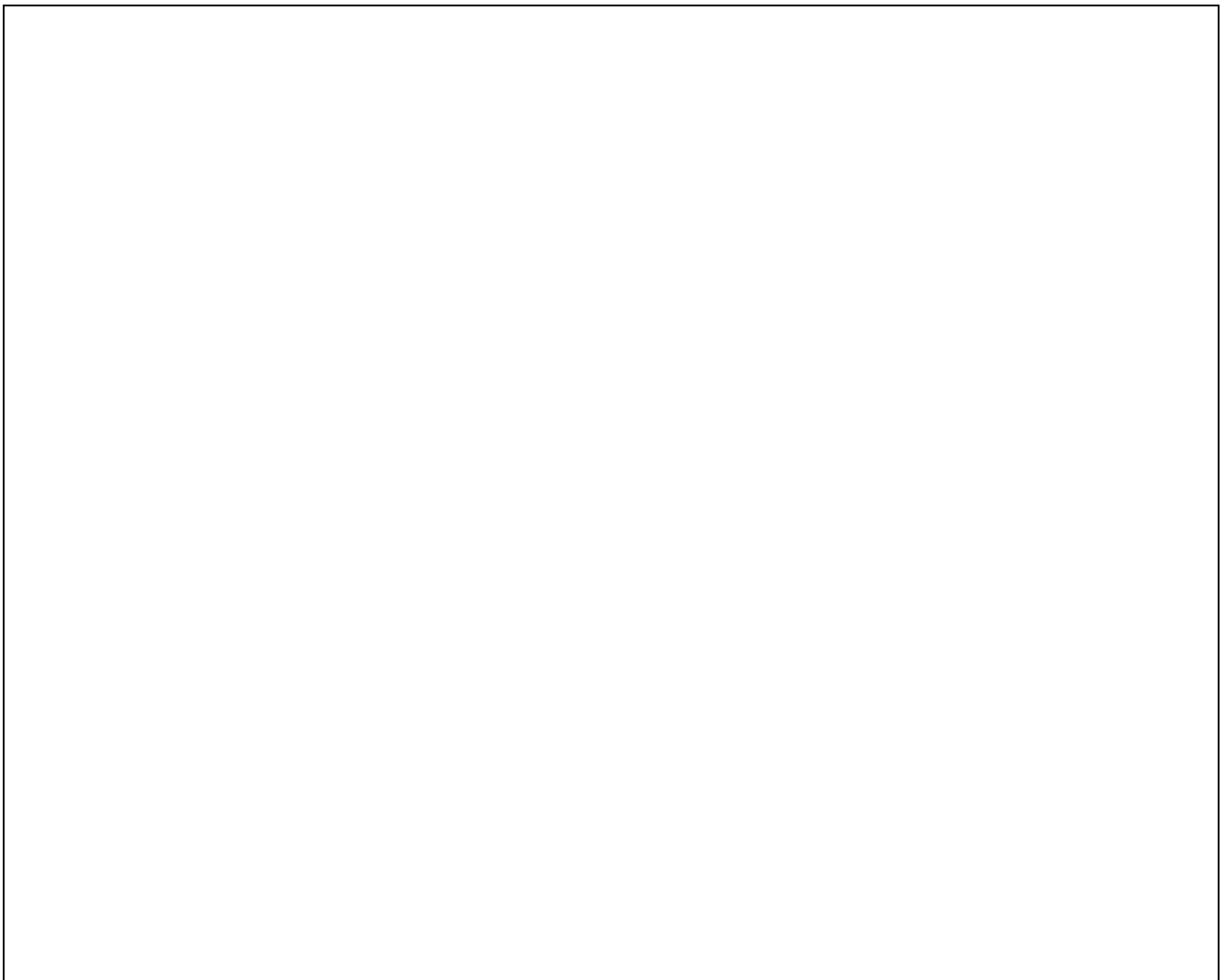
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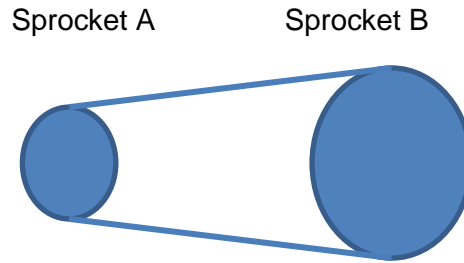
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Space for sketches for **Question 5.4**



**0 6****Figure 5** shows a chain and sprocket system similar to that used in machinery.**Figure 5****0 6****. 1**

The system has a ratio of 1:3. If sprocket A rotates  $360^\circ$ , how many degrees will sprocket B move? Show your working.

**[2 marks]**

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Space for sketches for question **6.2**

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**0 7 . 1** Bicycle headlights sometimes use lamps. The lamp has a resistance of 4 ohms and a supply of 2 volts.

Calculate the current. Include units in your answer. Show your working.

**[4 marks]**

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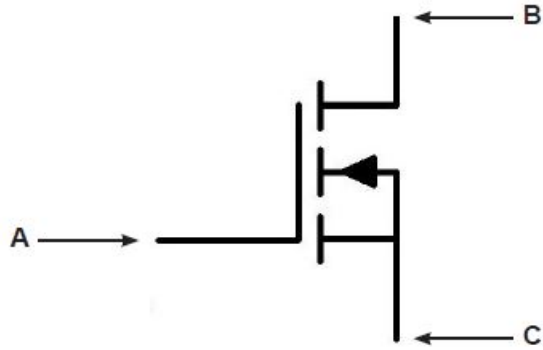
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**0 7 . 2** Name the three connections of the Field Effect Transistor shown in **Figure 6**. **[3 marks]**

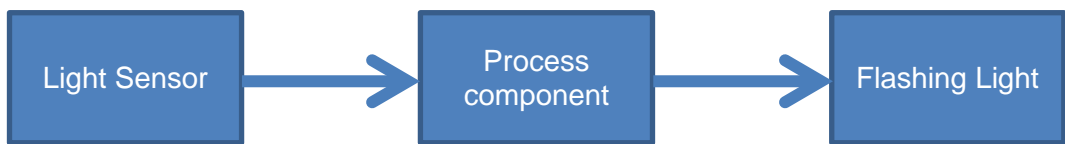
**Figure 6**



A \_\_\_\_\_  
 B \_\_\_\_\_  
 C \_\_\_\_\_

**0 7 . 3** **Figure 7** is a systems diagram that represents a bicycle headlight which automatically turns on at night.

**Figure 7**



Complete **Figure 8** with the names of suitable components which would allow the system to operate.

**Figure 8**



**[3 marks]**



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Using the information in **Table 2** and other considerations, state which battery type you would choose for the headlight and give reasons for your choice.

**[3 marks]**

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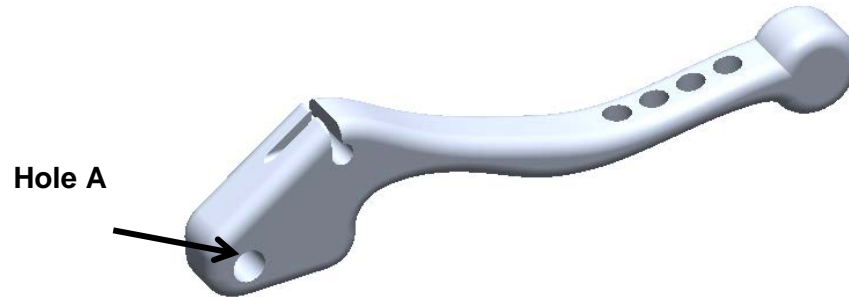
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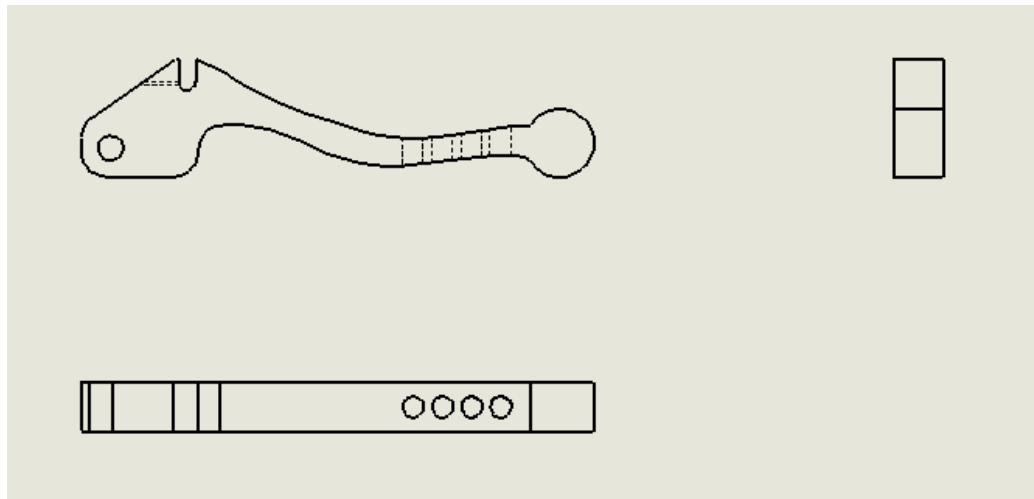
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07 . 6

**Figure 9** shows a brake lever from a bicycle. The lever is 12mm wide and has an overall length of 125mm. The pivot hole (labelled Hole A) has a radius of 3mm.

**Figure 9**

Using standard conventions, add **two** dimensions to **Figure 10** below.

**Figure 10****[4 marks]**



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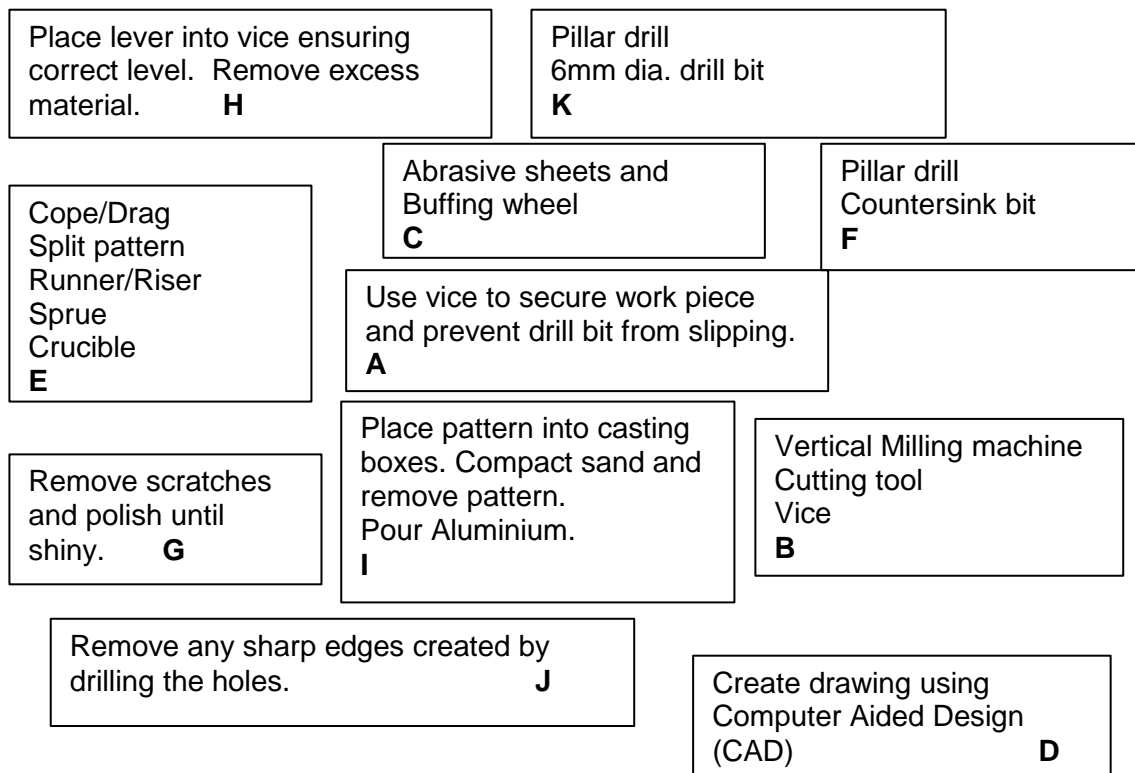
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**07 . 7**

Complete **Table 3** to create a production plan listing five major operations needed to manufacture the brake lever. Some parts have been completed for you. Select the others from the list given on **page 35** by inserting the identification **letter (A – J)** in the appropriate box.

**[10 marks]****Table 3**

<b>Order</b>	<b>Operation</b>	<b>Tools/Equipment</b>	<b>Description</b>
<b>1</b>	Cast the blank lever		
<b>2</b>	Machine the lever to correct size and tolerances		
<b>3</b>	Make holes for brake cable and ventilation		
<b>4</b>	Deburr holes		
<b>5</b>	Finish surface		



Turn over for the next question



**0 8**

Manufacturing equipment can be powered using mains electricity which can be generated using a variety of different methods. Considering at least two methods, evaluate the environmental impact of generating electricity.

**[8 marks]**

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**END OF QUESTIONS**

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3 November 2016