AQA

Please write clearly, in block capitals.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
ENGINEERING
Written Paper 8852/W

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.

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 ⬭

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]
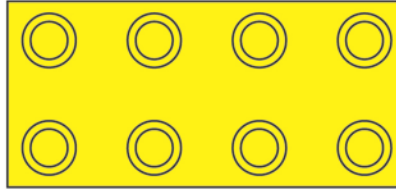
A Higher   ⬭

B Lower   ⬭

C Similar   ⬭

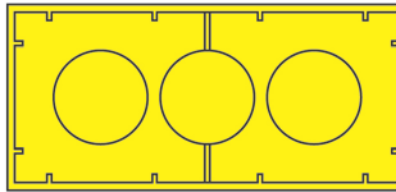**Turn over for the next question**

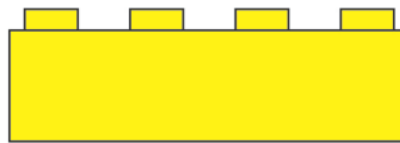**0 1 . 4** A toy brick is shown in **Figure 1**.

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 ⬭

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]

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

Shared characteristics

Ease of manufacture

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^3.

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]

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]

_____

_____

_____

_____

_____

_____

0 2 . 3

0 2 . 4 The steel sheet costs £2.80 per m².

To make 1 pan, the manufacturer uses:
- 0.25 m² 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 m²
Handle	67p
Rivet	1.5p

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

[3 marks]

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]

0 2 . 5

0 3 | **Figure 2** shows a crane lifting a concrete block.

Figure 2

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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]

0 3 . 2 The cable has a diameter of 29 mm and the force applied by the block is 1500 N.

Calculate the stress applied to the cable as it lifts the block using the following formulae:

Cross sectional area = πr^2
Stress = Force/Cross sectional area.

Give your answer to **three** significant figures.

Show your working.

[6 marks]

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]

---

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]

Turn over for the next question

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

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Showing bollard fully lowered

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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.
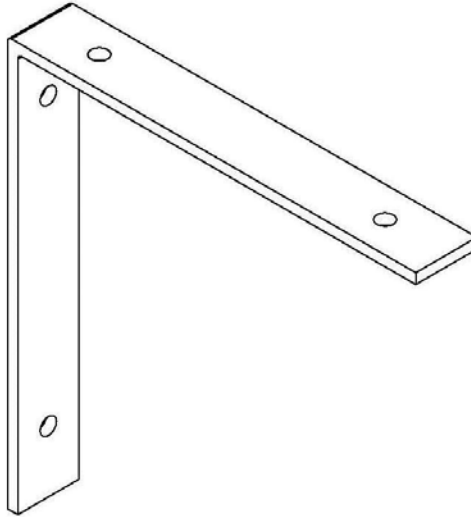
[3 marks]

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

0 5   A range of engineered products are manufactured using composite materials.

Carbon fibre reinforced polymer is an increasingly popular material.

0 5 . 1   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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ANSWER IN THE SPACES PROVIDED

0 5 . 2 Using notes and/or sketches in the space below and on **page 21**, describe the lay up process.

[6 marks]

Space for sketches for question **5.2**

0 5 . 3 Traditionally, boats were constructed from strips of wood held together by copper rivets. More recently there has been a change to using reinforced polymers.

Analyse the reasons for this change stating the advantages and disadvantages of each method of construction.

[6 marks]

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

[2 marks]
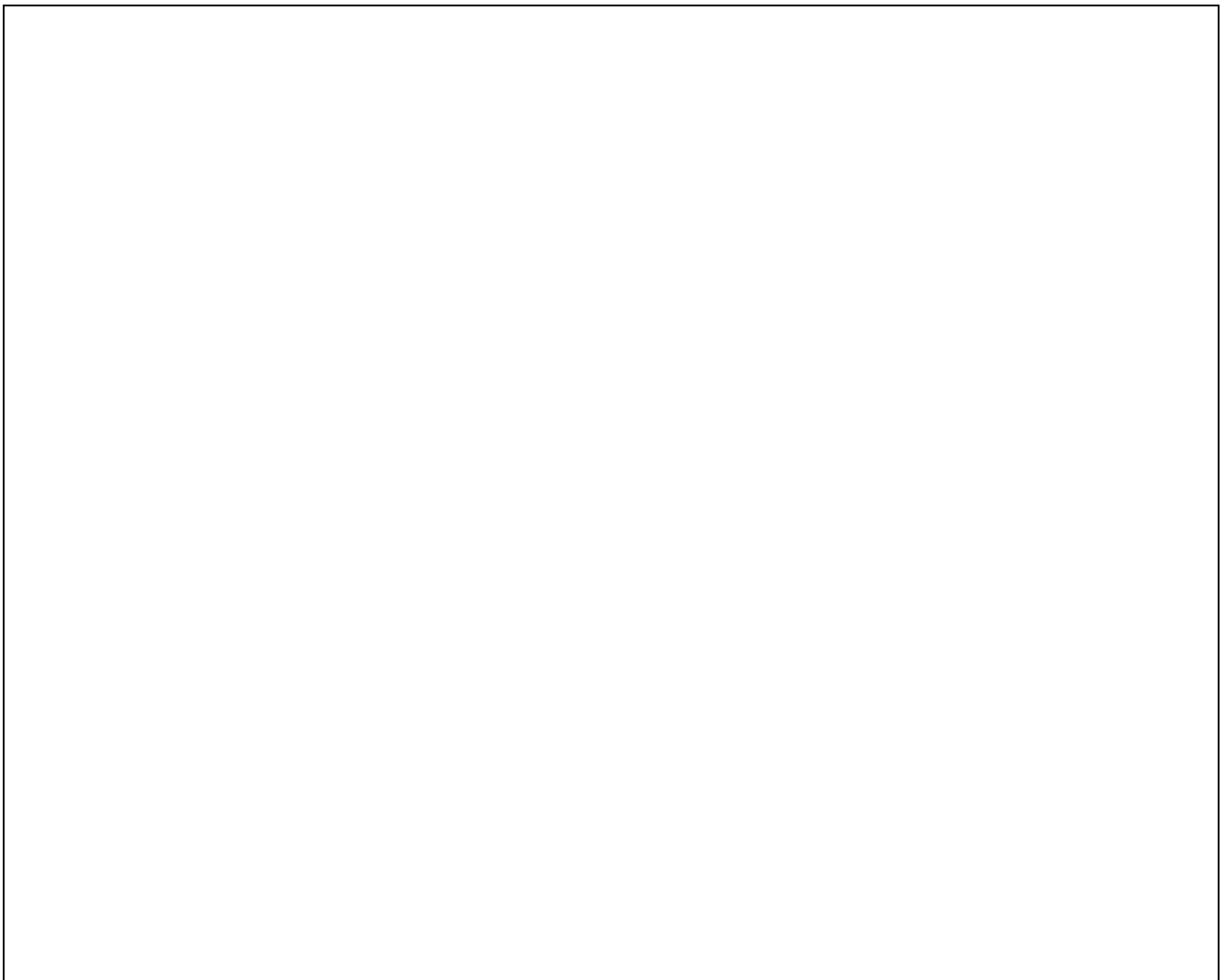
Space for sketches for **Question 5.4**

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

Figure 5

Sprocket A   Sprocket B
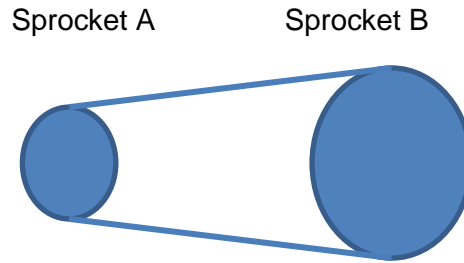
0 6 . 1   The system has a ratio of 1:3. If sprocket A rotates 360°, how many degrees will sprocket B move? Show your working.

[2 marks]

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0 6 . 2 Cams and followers can be used to convert rotary motion to reciprocating motion.

Using notes and sketches in the space below and on **page 27** describe how a cam and follower system works.

[6 marks]

Space for sketches for question **6.2**

| 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]

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

[3 marks]

Figure 6
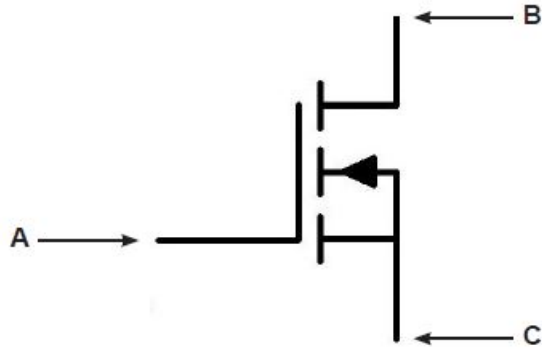
A _____

B _____

C _____

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

Figure 7

| Light Sensor | → | Process component | → | Flashing Light |

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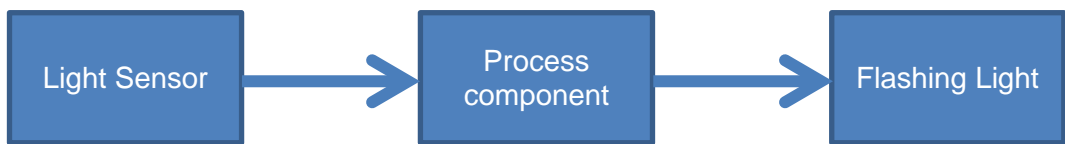
Figure 8

[3 marks]

0 7 . 4 The headlight needs a minimum of 4.5 volts to operate. **Table 3** shows a range of suitable batteries.

Using the information in the table recommend the most space-efficient way of powering the headlight. Show your working.

Table 2

Type of battery	Voltage (v)	Size (mm)	Weight (g)
PP3	9	26.5 x 17.5 x 48.5	46
AAA	1.5	10.5 (dia) x 44.5	14
AA	1.5	14.5 (dia) x 50.5	15

[5 marks]

Recommended battery

| 0 | 7 | . | 5 | 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]

_____

_____

_____

_____

_____

_____

_____

_____

Turn over for the next question

0 7 . 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

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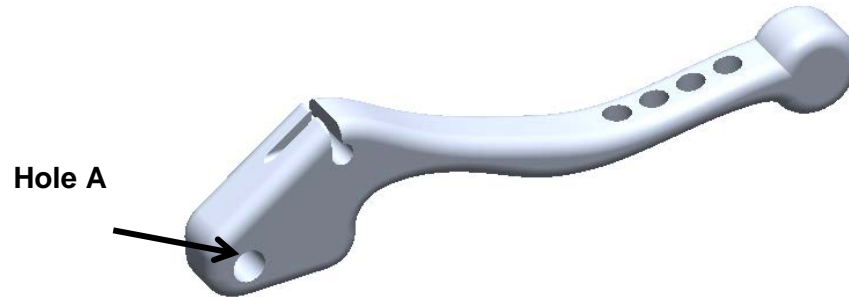
Using standard conventions, add **two** dimensions to **Figure 10** below.

Figure 10
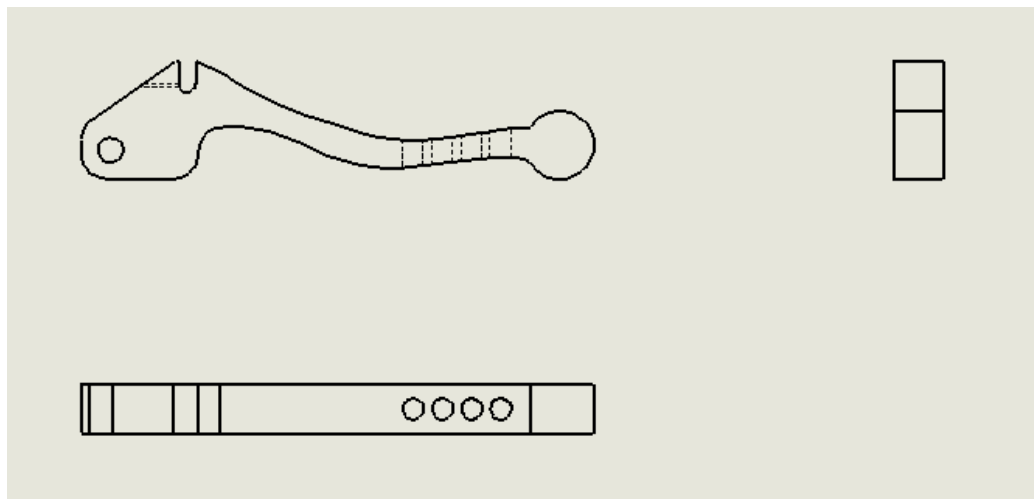
[4 marks]

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0 7 . 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

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

Place lever into vice ensuring correct level. Remove excess material.   **H**

Pillar drill
6mm dia. drill bit
K

Abrasive sheets and
Buffing wheel
C

Pillar drill
Countersink bit
F

Cope/Drag
Split pattern
Runner/Riser
Sprue
Crucible
E

Use vice to secure work piece
and prevent drill bit from slipping.
A

Place pattern into casting boxes. Compact sand and remove pattern.
Pour Aluminium.
I

Vertical Milling machine
Cutting tool
Vice
B

Remove scratches and polish until shiny.   **G**

Remove any sharp edges created by drilling the holes.   **J**

Create drawing using
Computer Aided Design
(CAD)   **D**

Turn over for the next question

0 7 . 8 Once manufactured, the brake lever needs to be checked for tolerance.
Name a tool that could be used to check the tolerance of the brake lever and
describe how this tool would be used to check the tolerance.

[3 marks]

Tool

How is the tool used?

0 7 . 9 A single lever has been sandcast as a prototype. This is now going into production.
Discuss **three** advantages of using pressure die casting instead of sandcasting to
make this component.

[3 marks]

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]

END OF QUESTIONS

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3 November 2016