Write your name here

Surname	Other names

Pearson Edexcel GCE

Centre Number	Candidate Number

Engineering

Unit 1: Engineering Materials, Processes and Techniques

Tuesday 13 May 2014 – Morning **Time: 1 hour 30 minutes**	Paper Reference **6931/01**

You do not need any other materials.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care on these questions with your spelling, punctuation and grammar, as well as the clarity of expression.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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PEARSON

Answer ALL questions. Write your answers in the spaces provided.

Some of the questions in this paper relate to an electrically powered bicycle as shown in Figure 1.

Figure 1

1 The materials used to manufacture the electrically powered bicycle can be grouped into classes.

From the materials listed, complete the following table by naming:

- the class of each material
- **one** different significant property of each material

Each answer must be different.

Specific material	**Class of material**	**Significant property of material**
Rubber		
Duralumin		
Glass reinforced plastics (GRP)		
Cast iron		

(Total for Question 1 = 8 marks)

2 The table below lists four processes used in the manufacture of the electrically powered bicycle.

Complete the table by giving, for each process:

- **one** risk involved in each process
- **one** different precaution/control measure used to prevent injury

Each answer must be different.

Process	Risk	Precaution/Control measure
Mechanical sawing of metal tube		
Final electrical testing		
Spot welding		
Centre lathe turning		

(Total for Question 2 = 8 marks)

3 The table below shows the properties of some materials used in the manufacture of the electrically powered bicycle.

Material	Density kg m^{-3}	Electrical resistivity ohm-m	Tensile strength MN m^{-2}	Coefficient of friction μ
Rubber	1200	10^{11}	30	0.8
PVC	1040	10^{12}	50	0.2
Brass	8360	9.0×10^{-8}	500	0.35
Aluminium alloy	2700	27.0×10^{-8}	82	0.61
Copper	8960	1.68×10^{-8}	215	0.53
Stainless steel	8000	11.2×10^{-8}	630	0.68

Using the information in the table, select the most appropriate material to use for the following parts of the electrically powered bicycle and explain your choice.

(a) The sprocket that turns the chain.

(i) Material

(1)

.....

(ii) Explanation

(2)

.....

.....

.....

.....

(b) The brake block that stops the wheel turning.

(i) Material

(1)

(ii) Explanation

(2)

(c) The spokes that link the outer rim to the centre spindle.

(i) Material

(1)

(ii) Explanation

(2)

(d) The insulation around the power cable.

(i) Material

(1)

(ii) Explanation

(2)

(Total for Question 3 = 12 marks)

4 Manufacturers rely on both permanent and temporary joining methods when producing products such as the electrically powered bicycle.

(a) State **one** type of permanent joint on a bicycle.

(1)

.....

(b) State **two advantages** of using the permanent joint you have identified.

(2)

1 .....

.....

2 .....

.....

(c) State **two disadvantages** of using the permanent joint you have identified.

(2)

1 .....

.....

2 .....

.....

(d) The MIG (metal inert gas) welding process can be used to form a joint on the electrically powered bicycle.

Describe, using notes and sketches, the MIG welding process.

(6)

(Total for Question 4 = 11 marks)

5 Parts of the electrically powered bicycle are machined.

The component in Figure 2 shows a spigot which is turned off-centre on a centre lathe.

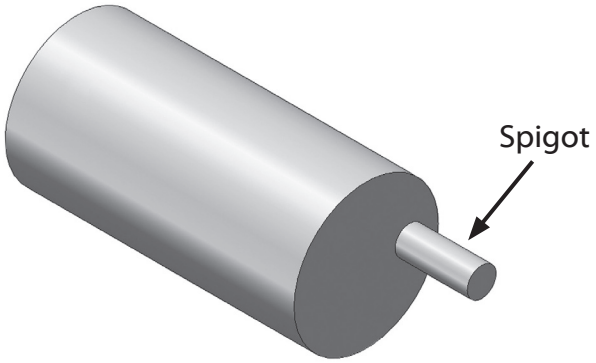

Figure 2

(a) State the name given to this type of turning.

(1)

.....

(b) When produced, this component is held in a four-jaw chuck.

Explain the operating differences between a three-jaw and a four-jaw chuck.

(3)

.....

.....

.....

.....

.....

.....

(c) Describe, using notes and sketches, how an operator would set up the centre lathe to manufacture the component shown in Figure 2.

(6)

(d) Describe, using notes and sketches, the procedure for correctly setting the cutting tool height on a centre lathe.

(4)

(Total for Question 5 = 14 marks)

6 Certain component parts of the electrically powered bicycle can be made from polymers.

(a) Name **one** thermosetting polymer.

(1)

(b) Name **one** thermoplastic polymer.

(1)

(c) Describe the molecular structure and features of a thermosetting polymer.

(4)

(d) Describe the molecular structure and features of a thermoplastic polymer.

(4)

(e) Explain how sunlight can degrade some polymers.

(3)

(f) Where two different metals meet on the electrically powered bicycle frame one will corrode earlier than the other. This is called galvanic corrosion.

Describe the process of galvanic corrosion.

(3)

(g) A cut-off switch that operates when a set temperature is exceeded is incorporated into the recharging system of the electrically powered bicycle.

Explain why shape memory alloys could be used for the switch.

(2)

(Total for Question 6 = 18 marks)

7 It is intended to offer an accessory for the electrically powered bicycle where the cyclist can transport a small child safely.

Using notes and sketches, design a trailer that can be temporarily attached to the electrically powered bicycle.

Your design must include:

- a trailer that must be stable when in use
- a temporary method of locking the trailer to the electrically powered bicycle frame
- a trailer that can carry a young child
- a safe method of securing the child into your trailer design
- a choice of materials and reasons for their use in the design

Produce your design on page 15

Answer page for Question 7

(Total for Question 7 = 10 marks)

***8** The following materials were considered for the frame of the electrically powered bicycle:

- mild steel
- carbon fibre

Evaluate these materials with particular reference to the design needs of the product to determine the most appropriate for the bicycle frame.

(Total for Question 8 = 9 marks)

TOTAL FOR PAPER = 90 MARKS