

Write your name here	
Surname	Other names
Centre Number	Candidate Number
<b>Edexcel GCE</b>	
<h1>Engineering</h1> <h2>Unit 1: Engineering Materials, Processes and Techniques</h2>	
Monday 17 May 2010 – Afternoon <b>Time: 1 hour 30 minutes</b>	Paper Reference <b>6931/01</b>
<b>You do not need any other materials.</b>	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.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

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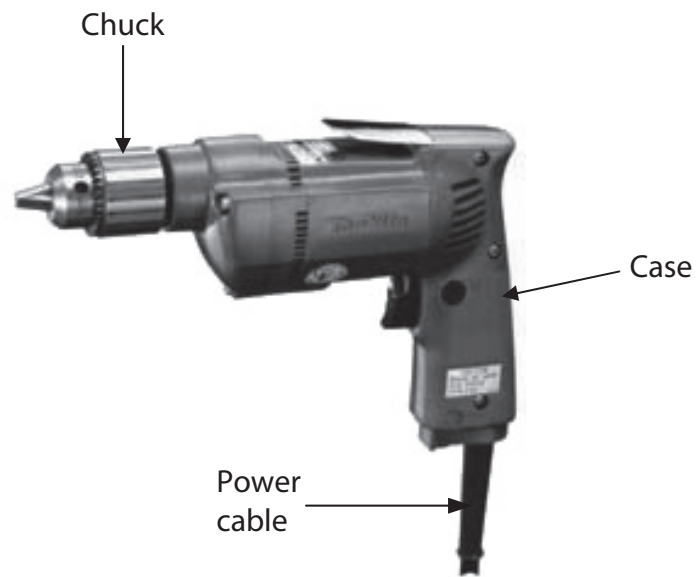


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**Answer ALL questions. Write your answers in the spaces provided.**

Many of the questions in this paper relate to an electric hand-held drill similar to the one shown in Figure 1.



**Figure 1**

**1** The materials used to manufacture the hand-held electric drill can be grouped into classes.

Complete the following table by giving:

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

Specific material	Class of material	Significant property of material
Cast Iron		
Copper		
Duralumin		
ABS		

**Table 1**

**(Total for Question 1 = 8 marks)**



2 (a) Table 2 below lists four processes that could be used in the manufacture of the electric hand drill.

Complete the following table by stating:

- **one** hazard or risk associated with each process
- **one** different control measure or precaution that will help reduce the risk.

(8)

Process	Hazard or risk	Control measure or precaution
Chemical etching		
Soft soldering		
Metal turning		
MIG welding		

**Table 2**

(b) Soft soldering is a process that has been used in the construction of the electronic circuit of the hand-held electric drill.

Describe the process of soft soldering when applied to electronic circuits.

(3)

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(c) Describe the process of chemical etching.

(3)

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**(Total for Question 2 = 14 marks)**

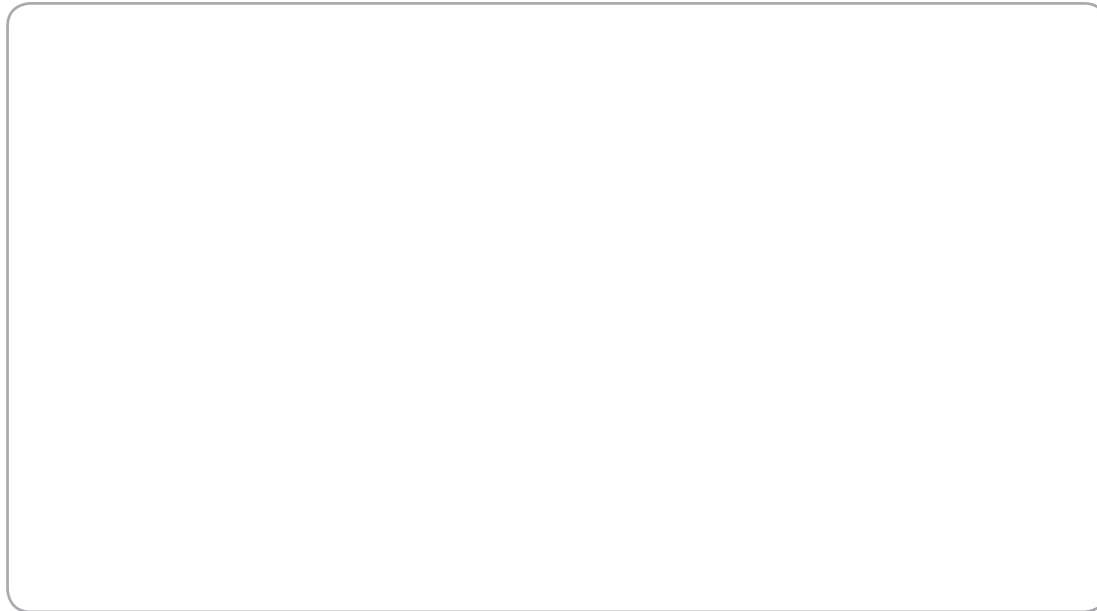


**3** The component parts of the hand-held electric drill are manufactured using various processes.

(a) The case of the hand-held electric drill has been manufactured using injection moulding.

Using notes and/or sketches, describe the injection moulding process.

(4)



(b) Outline the purpose and method of the following processes:

(i) Annealing copper

(4)

Purpose

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Method

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(ii) Case hardening low carbon steel

(4)

Purpose

Method

(Total for Question 3 = 12 marks)



4 Table 3 below gives a list of materials and some of their properties.

Material	Density (kg m <sup>-3</sup> )	Thermal conductivity (Wm <sup>-1</sup> K <sup>-1</sup> )	Resistivity (Ω m)	Tensile strength (MN m <sup>-2</sup> )
Aluminium	2700	180	$2.7 \times 10^{-8}$	455
Copper	8960	385	$1.7 \times 10^{-8}$	220
Low carbon steel	7880	65	$10.6 \times 10^{-8}$	700
High carbon steel	7840	43	$8.7 \times 10^{-8}$	760
PVC	1040	0.16	1011	50
Stainless steel	7800	16	$8.4 \times 10^{-8}$	630

**Table 3**

For each of the following component parts of the hand-held electric drill choose a suitable material and give an explanation of your choice.

(a) Electrical connectors

(i) Material

(1)

(ii) Explanation

(2)



(b) Insulation on the power cables

(i) Material

(1)

(ii) Explanation

(2)

(c) The drill chuck

(i) Material

(1)

(ii) Explanation

(2)

**(Total for Question 4 = 9 marks)**



5 (a) The case of the hand-held electric drill has been manufactured in two halves.

Explain why the case of the hand-held electric drill has been manufactured in two halves.

(2)

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(b) Different methods of joining the two sides of the drill case would have been considered by the product's designers.

Suggest **one** method of joining the two sides of the drill together and justify your choice.

(3)

Method of joining

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Justification

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(c) When selecting materials engineers need to make their choice with care.

Describe the effect that ultraviolet (UV) light has on some polymers.

(3)

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(Total for Question 5 = 8 marks)





**6** Different materials and methods of manufacture would have been considered prior to the production of the hand-held electric drill.

(a) Mild steel may have been considered as one of the materials in the electric drill. Explain why mild steel is usually painted or protected in some way.

(4)

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(b) Describe the workings of a Piezo-electric actuator.

(2)

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(c) Describe the process of laminating glass reinforced plastic (GRP).

(6)

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**(Total for Question 6 = 12 marks)**



7 In order to improve or change properties, some components of the hand-held electric drill have been "finished".

(a) Describe the following processes:

(i) Anodising

(4)

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(ii) Plastic coating

(3)

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(b) Describe **one** advantage of using self-finishing materials.

(2)

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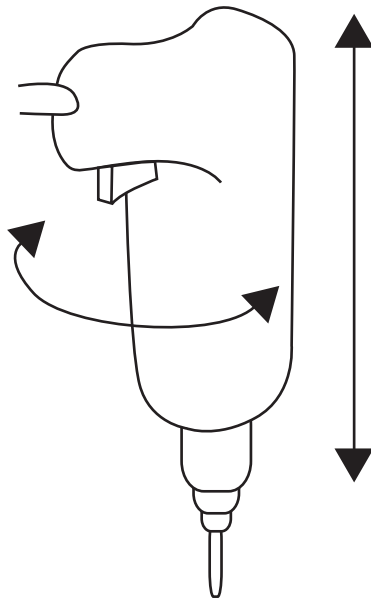
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(Total for Question 7 = 9 marks)



- 8 It has been decided to market a holder for the hand-held drill to enable it to be converted into a small pillar drill.



Using notes and sketches, design a device for moving the drill vertically up and down.

Your design must include the following:

- a method of moving the drill vertically up and down at least 150mm
- a method of returning the drill back to its original position once the hole has been drilled
- a device to produce leverage to enable the drill to be moved
- the drill must be able to turn through 180° and be locked in any position.

(Total for Question 8 = 12 marks)



**\*9** Possible materials for the case of the hand-held electric drill are aluminium alloy or ABS.

Discuss the advantages and disadvantages of using either aluminium alloy or ABS for the case of the electric hand-held drill.

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**(Total for Question 9 = 6 marks)**

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**TOTAL FOR PAPER = 90 MARKS**

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