Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	9	3	1	/	0	1	Signature	

Paper Reference(s)

6931/01

Edexcel GCE

Engineering

Advanced Subsidiary

Unit 1: Engineering Materials, Processes and Techniques

Thursday 14 May 2009 – Afternoon

Time: 1 hour 30 minutes

Materials required for examination
Pencil, pen

Items included with question papers
Nil

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
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7	
8	
9	
Total	

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.
Check that you have the correct question paper.
Answer ALL the questions. Write your answers in the spaces provided in this question paper.

Information for Candidates

The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 9 questions in this question paper. The total mark for this paper is 90.
There are 16 pages in this question paper. Any blank pages are indicated.
You may use a calculator.
You may use drawing equipment. If pencil is used for diagrams/sketches, it must be dark (HB or B).
Coloured pens, pencils and highlighter pens must **not** be used.

Advice to Candidates

You are reminded of the importance of clear English and careful presentation in your answers.
Include diagrams in your answers where these are helpful.

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

Most of the questions in this paper relate to a washing machine, such as the one shown in Figure 1.

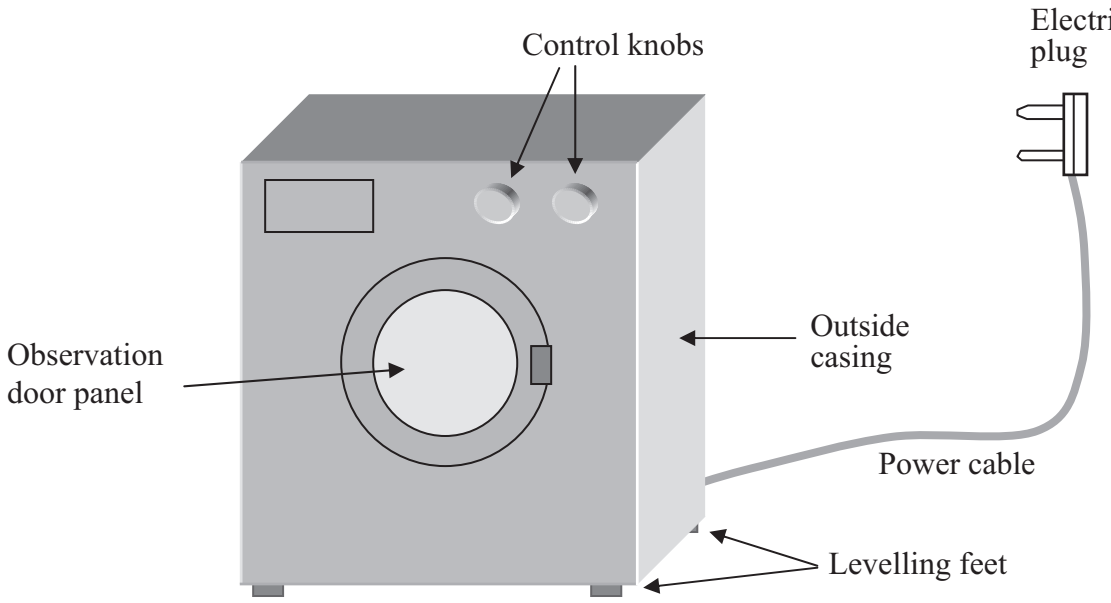

Figure 1

1. The table below lists three processes used in manufacturing the washing machine.

Complete the table by giving:

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

Process	**Risk**	**Precaution/Control measure**
Handling metal sheets		
Drilling		
Spray painting		

Q1

(Total 6 marks)

Leave blank

2. (a) The materials used to manufacture the washing machine can be grouped into classes.

Complete the following table, by naming **one** specific material for each class listed, and stating **one** significant property of that material.

Class of material	**Specific material**	**Significant property of material**
Non-ferrous alloy		
Thermoplastic polymer		
Thermosetting polymer		
Adhesive		

(8)

(b) Inside the washing machine there is a block of cast iron, the purpose of which is to give stability to the machine.

(i) State to which class of material cast iron belongs.

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(1)

(ii) Give **two** reasons why cast iron gives stability.

1 .....

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2 .....

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(2)

(Total 11 marks)

Q2

Leave blank

3. The outer case of the washing machine motor is made using the pressure die casting process.

(a) Describe the process of pressure die casting.

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(6)

Sand casting is an alternative process that could have been used.

(b) Describe **two** advantages of using pressure die casting compared to sand casting.

Advantage 1 .....

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Advantage 2 .....

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(4)

(Total 10 marks)

Q3

Leave blank

4. The table below shows some materials used in making the washing machine, and their properties.

Material	Density (kg m^{-3})	Electrical resistivity (Ω m)	Tensile strength (MN m^{-2})	Thermal conductivity (W m^{-1} K^{-1})	Material cost relative to aluminium
Aluminium	2700	2.7×10^{-8}	82	237	1
Low carbon steel	7860	10.6×10^{-8}	690	63	0.2
Copper	8960	1.68×10^{-8}	215	385	1
Urea formaldehyde (UF)	1250	$>10^{11}$	70	0.15	0.7
Brass	8360	9.0×10^{-8}	500	88	1.3
Borosilicate glass	2800	$>10^{12}$	50	1.1	0.6

Using the information in the table and your knowledge of materials, select the most appropriate material to use for the following parts of the washing machine and explain your choice.

(a) The connecting wire from the motor to the electric plug.

(i) Material .....

(1)

(ii) Explanation

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(2)

Leave blank

(b) The observation door panel.

(i) Material .....
(1)

(ii) Explanation

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(2)

(c) The control knobs.

(i) Material .....
(1)

(ii) Explanation

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(2)

Q4

(Total 9 marks)

Leave blank

5. Heat treated steel is used in the manufacture of some washing machine parts.

(a) Describe the heat treatment used to increase the hardness of high carbon steel.

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(3)

(b) Describe the process of tempering.

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(3)

(c) Describe the purpose and process of normalising.

(i) Purpose .....

(1)

(ii) Process .....

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(2)

Q5

(Total 9 marks)

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6. For each of the following ‘new’ or ‘smart’ materials explain why they are suitable for the application given.

New (smart) material	Application
Shape memory alloy	Greenhouse window opener
Heat shrink sleeving	Insulating soldered joints in electronics

(a) (i) Shape memory alloy.

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(3)

(ii) Heat shrink sleeving.

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(3)

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(b) Heat shrink sleeving is manufactured using the plastic extrusion process. Use notes and a sketch to describe the plastic extrusion process.

(5)

Q6

(Total 11 marks)

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7. A washing machine contains an electric motor which turns an inner drum, inside a fixed outer drum. Figure 2, illustrates this.

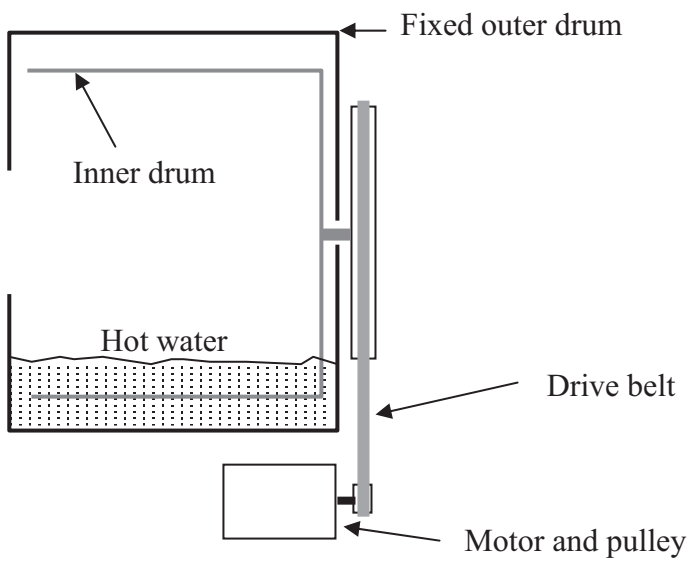

Figure 2

The inner drum can rotate at high speed.

(a) Explain **one** advantage and **one** disadvantage of making a washing machine inner drum from a metal rather than from a plastic material.

(i) Advantage .....

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(2)

(ii) Disadvantage .....

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(2)

Leave blank

(b) (i) From the metals listed below, state which is most suitable for the inner drum of a washing machine.

- Low carbon steel
- High carbon steel
- Stainless steel
- Aluminium.

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(1)

(ii) Explain why this metal is most suitable for a washing machine inner drum.

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(2)

(c) Name **one** suitable material for producing drive belts, such as that shown in Figure 2, and justify your choice of material.

(i) Material .....

(1)

(ii) Justification .....

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(2)

Q7

(Total 10 marks)

Leave blank

8. (a) Explain the purpose of the levelling feet on a washing machine, as shown in Figure 1.

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(2)

(b) Using notes and sketches, design a foot levelling device for a washing machine.

Use the following information in your design:

- locating hole for foot in the washing machine base threaded M10
- range of required foot adjustment 10mm.

Your design must include a method of:

- fixing the device to the base of the washing machine
- adjusting the foot.
- limiting the effects of vibration on the adjustment
- protecting the floor from damage from the foot.

(10)

(Total 12 marks)

Q8

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9. (a) Describe what is meant by the following properties of engineering materials.

(i) Ductility.

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(2)

(ii) Malleability.

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(2)

(iii) Toughness.

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(2)

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(b) The following materials were considered for the outside casing of the washing machine:

- mild steel (painted)
- stainless steel
- polycarbonate.

Discuss the advantages and disadvantages of these materials in this application.

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(6) Q9

(Total 12 marks)

TOTAL FOR PAPER: 90 MARKS

END