



Most of the questions in this paper relate to an electric hairdryer, a diagram of which is shown below in Figure 1.

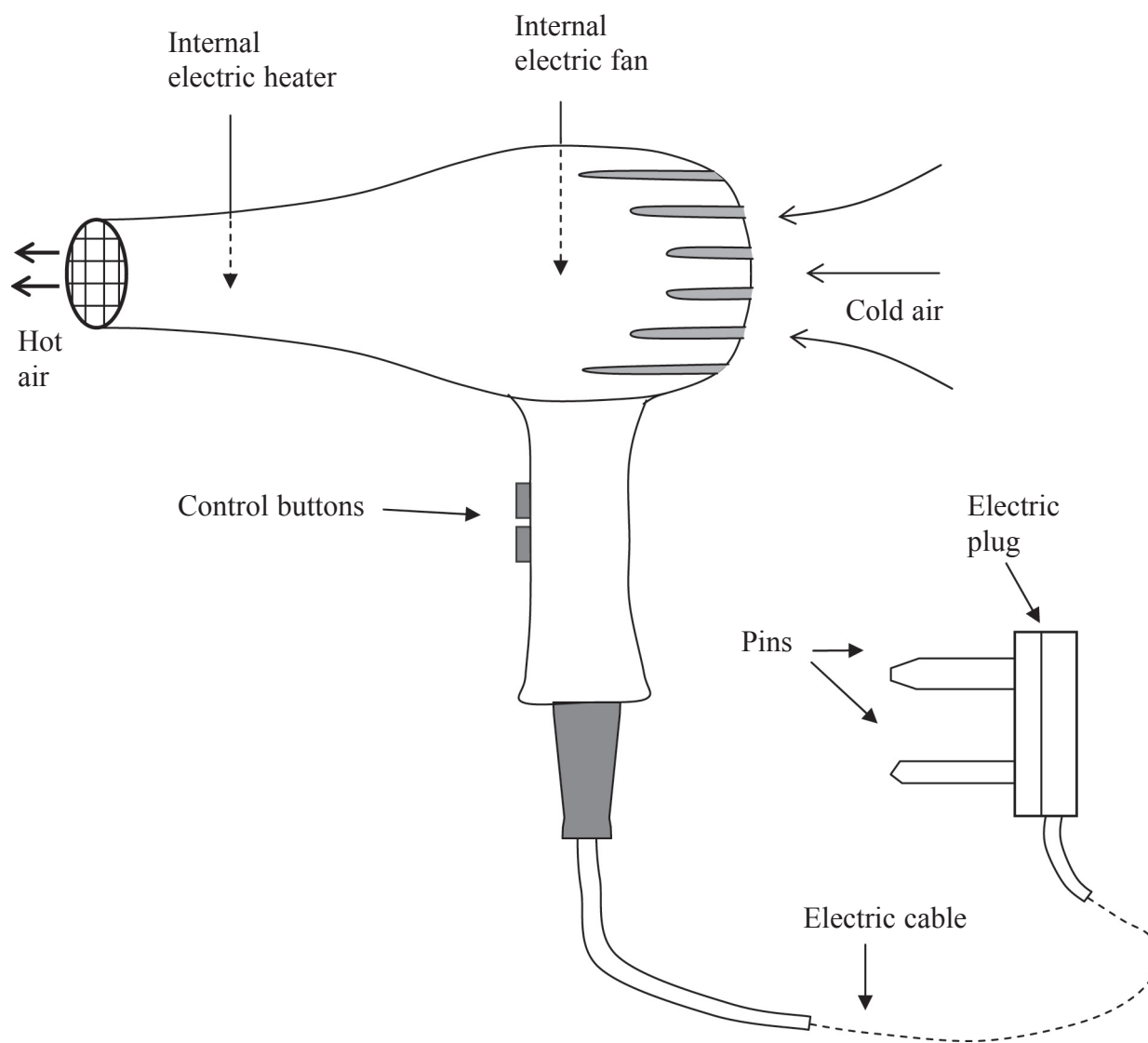


Figure 1



Leave blank

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

1. A number of different processes are used to manufacture the hairdryer.

Complete the following table, to give **one** hazard/risk involved in using each process, and **one different** precaution/control measure which will prevent this hazard/risk resulting in an injury.

The first one has been completed for you.

Process	Hazard/Risk	Precaution/Control measure
Final electrical testing	Electrical shock	Insulated wire
PCB (printed circuit board) production		
Drilling		
Soft soldering		

Q1

(Total 6 marks)

2. Engineering materials can be grouped into classes.

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

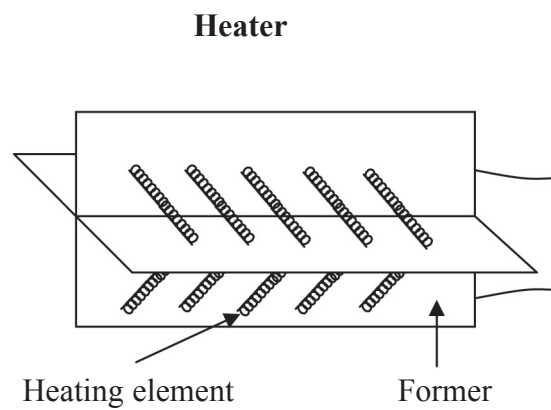
Class of material	Specific material	Significant property of material
Non-ferrous metal		
Ferrous metal		
Alloy		
Elastomer		

Q2

(Total 8 marks)



3. One of the main internal parts of the hairdryer is the heater, which is shown below in Figure 2.  
The heating element consists of a coiled wire, which is fixed to a support or former.



**Figure 2**

- (a) The following table shows the properties of some materials:

	Density ( $\text{kg m}^{-3}$ )	Melting point (K)	Resistivity ( $10^{-8} \Omega\text{m}$ )
<b>Aluminium</b>	2700	933	2.7
<b>Copper</b>	8960	1356	1.7
<b>Iron</b>	7870	1810	9.7
<b>PVC</b>	1040	358	$> 10^{11}$
<b>Tungsten</b>	19300	3410	5.5

- (i) State which material is **most** appropriate for the wire in the electrical element.

.....  
(1)

- (ii) Explain your choice.

.....  
.....  
(2)

- (iii) Explain why wires in heaters are often coiled.

.....  
(1)



Leave  
blank

(b) The heater wire is fixed onto the former.

(i) State **two** important properties the former must have.

1 .....

2 .....

(2)

(ii) State the class of material that the former would be made from.

.....

(1)

(iii) Identify **one** specific material that the former could be made from.

.....

(1)

Q3

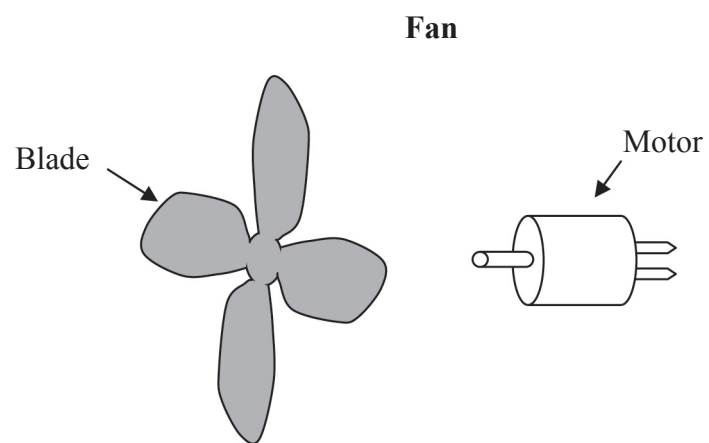
(Total 8 marks)

5

Turn over



4. The fan consists of a blade which is rotated by an electric motor, as shown below in Figure 3.



**Figure 3**

(a) (i) State **one** material that would be suitable for the blade and provide **four** reasons for choosing the material:

Material ..... (1)

Reasons

- 1 .....
- 2 .....
- 3 .....
- 4 ..... (4)

(ii) State a method of mass production that would be used to manufacture the blade from the material you have chosen, and explain **four** key stages of the manufacturing process.

Method of mass production ..... (1)

Key stages of the method

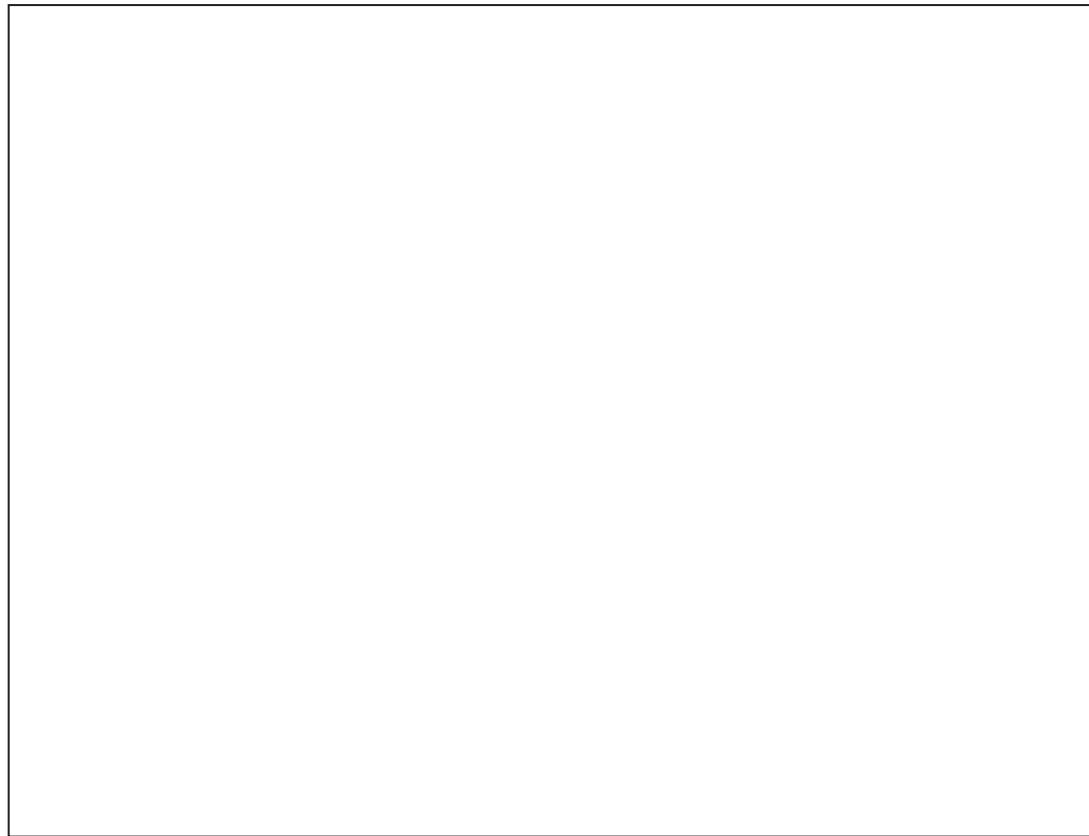
- 1 .....
- 2 .....
- 3 .....
- 4 ..... (4)



Leave  
blank

(b) The shaft of the motor must be fixed to the blade. Describe, using notes and sketches, **one** suitable method of attaching the blade to the shaft of the motor.

Sketches



Description .....

.....

.....

.....

(6)

Q4

(Total 16 marks)

7

Turn over



Leave blank

5. By analysing relevant data from the table below and using your own knowledge of materials, compare and contrast the suitability of using different materials for making the following parts of the hairdryer. Justify your selection of the most appropriate material.

Material	Density (kg m <sup>-3</sup> )	Electrical resistivity (Ω m)	Tensile strength (MN m <sup>-2</sup> )	Thermal conductivity (W m <sup>-1</sup> K <sup>-1</sup> )	Material cost, relative to aluminium
Aluminium (pure)	2800	$2.85 \times 10^{-8}$	82	180	1
PVC	1040	$>10^{11}$	50	0.15	0.3
Low carbon steel	7860	$10.6 \times 10^{-8}$	690	63	0.2
Brass	8360	$9.0 \times 10^{-8}$	500	88	1.3
ABS	1060	$> 10^{11}$	60	0.19	0.5

(a) The pins on the electric plug.

.....  
.....  
.....  
.....

(4)

(b) The outer covering of the electric cable.

.....  
.....  
.....  
.....

(4)

(Total 8 marks)

Q5





Leave blank

6. (a) Give **one** example of a thermoplastic polymer and **one** example of a thermosetting polymer.

Thermoplastic ..... (1)

Thermosetting ..... (1)

(b) Describe, with the aid of notes and sketches, the difference in **structure** between thermoplastic and thermosetting polymers.

Thermoplastic	Thermosetting

.....  
..... (4)

(c) Describe the differences in **properties** between thermoplastic and thermosetting polymers.

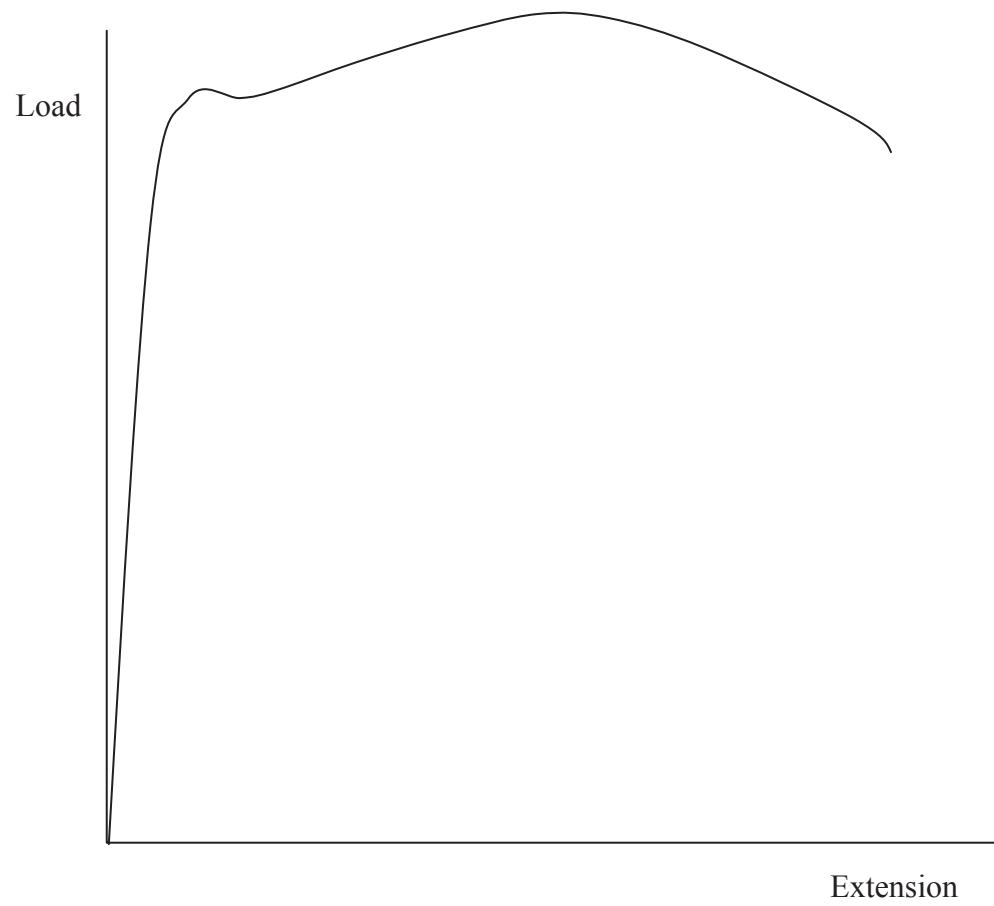
.....  
.....  
.....  
..... (4)

(Total 10 marks)

Q6



7. A load–extension curve for low carbon steel is shown below.



(a) Indicate, using an arrow and label, the points on the curve which correspond to:

(i) the UTS (ultimate tensile strength) (1)

(ii) the elastic limit (1)

(iii) the area of plastic deformation (1)

(b) Describe what is meant by:

(i) the elastic limit  
.....  
..... (2)

(ii) plastic deformation  
.....  
..... (2)



Leave  
blank

- (c) The stress and strain are calculated from the forces that act on the specimen being tested, and from the dimensions of the specimen.

A specimen which is 60 mm long is stretched by 0.2 mm when a force of 3000 N is applied. The specimen has a cross-sectional area of  $20 \times 10^{-6} \text{ m}^2$ .

Calculate, for this specimen:

- (i) the strain

formula ..... (1)

working calculation

.....  
..... (2)

Give your answer here ..... (2)

- (ii) the stress

formula ..... (1)

working calculation

.....  
..... (2)

Give your answer, including units, here ..... (2)

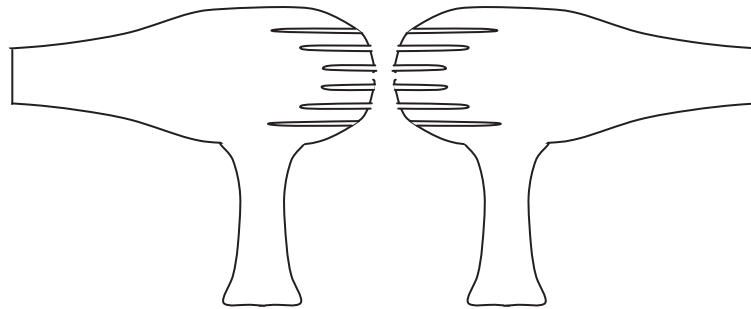
**(Total 17 marks)**

Q7

--	--



8. The casing for the hairdryer is made in two halves, as shown. The two halves are subsequently joined together.



(a) Give **three** reasons for making the casing in two sections, rather than as one single piece.

- 1 .....
- 2 .....
- 3 .....

**(3)**

(b) Describe how the two halves of the casing can be joined together to allow for maintenance and repair.

- .....
- .....
- .....

**(3)**



Leave  
blank

(c) In deciding which material to use for the casing, two materials are considered: stainless steel and ABS (acrylonitrile butadiene styrene).

(i) Discuss the relative advantages and disadvantages of these materials in this application.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

(8)

(ii) Select the one which is best for the casing, briefly stating **two** reasons for your choice.

Best final choice .....

(1)

Reasons

1 .....

2 .....

(2)

Q8

(Total 17 marks)

**TOTAL FOR PAPER: 90 MARKS**

**END**



**BLANK PAGE**



**BLANK PAGE**



**BLANK PAGE**

