

Mark Scheme (Results) Summer 2007

GCE

GCE Engineering (8731/9731)

GCE Engineering: Engineering Materials, Processes and Techniques
6931/01 Mark Scheme

Question Number Question

6931_01_Q01

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.

Answer

Part
Mark

Total
Mark

Process	Hazard/Risk	Precaution/Control Measure
PCB (printed circuit board) production	Chemical burns / fume inhalation	Use gloves / ventilation
Drilling	Swarf flying into eye / workpiece rotating	Wear goggles / clamp workpiece
Soft soldering	Fume inhalation, (fumes)/burns	fume extraction / use holder for iron

Precaution must match hazard, but no follow-on allowed.

6x1

(6)

(Total 6 marks)

Question Number

Question

6931_01_Q02

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.

Answer

Part
Mark

Total
Mark

Class of material	Specific material	Significant property of material
Non-ferrous metal	aluminium, brass, gold	Lightweight, non-magnetic or good conductor of electricity
Ferrous metal	any steel eg low carbon steel	Magnetic or high tensile strength
Alloy	Aluminium alloy / Duralumin (or dural) / solder / steel / nickel alloy	lightweight / conducting
Elastomer	Rubber, neoprene	Highly elastic or shock absorbent

8x1

(8)

Property must follow material but no follow-on allowed

(Total 8 marks)

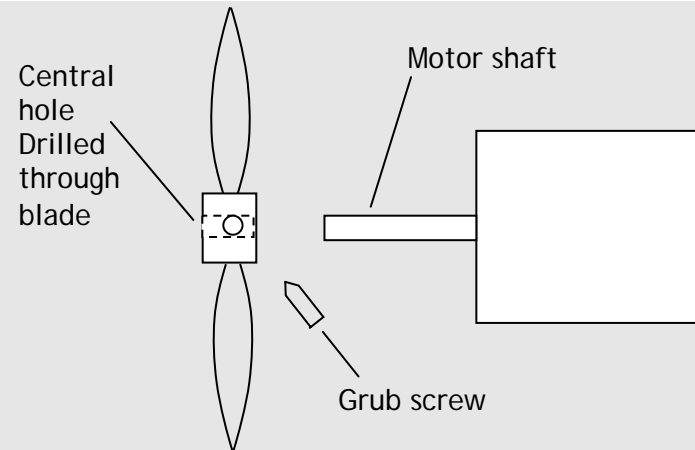
Question Number	Question		
6931_01_Q03ai	<p>One of the main internal parts of the hairdryer is the heater, which is shown below in Figure 2. The heating element consists of a coiled wire, which is fixed to a support or former. The following table shows the properties of some materials.</p> <p>State which material is most appropriate for the wire in the electrical element.</p>		
	Answer	Part Mark	Total Mark
	Tungsten (<i>only answer</i>)	1	(1)
Question Number	Question		
6931_01_Q03aii	<p>Explain your choice.</p>		
	Answer	Part Mark	Total Mark
	<p>Any one of the following:</p> <ul style="list-style-type: none"> • Has the highest melting point • Will resist oxidation • Has a reasonably high resistivity <p><i>Do not accept 'high melting point'.</i></p>	2x1	(2)

Question Number	Question		
6931_01_Q03aiii	Explain why wires in heaters are often coiled.		
	Answer	Part Mark	Total Mark
	Any one of the following: <ul style="list-style-type: none"> To increase the length or resistance To increase the surface area of the coil 	1x1	(1)
Question Number	Question		
6931_01_Q03bi	The heater wire is fixed onto the former. State two important properties the former must have.		
	Answer	Part Mark	Total Mark
	Any two of the following: <ul style="list-style-type: none"> Able to withstand high temperatures be an insulator rigid/strong/robust 	2x1	(2)

Question Number	Question		
6931_01_Q03bii	State the class of material that the former would be made from.		
	Answer	Part Mark	Total Mark
	A ceramic	1	(1)
	<i>Accept phonetic spelling eg seramic, siramic</i>		
Question Number	Question		
6931_01_Q03biii	Identify <u>one</u> specific material that the former could be made from.		
	Answer	Part Mark	Total Mark
	Any one of the following:		
	<ul style="list-style-type: none"> • Porcelain • Alumina • Mica • Pyrex/borosilicate glass 	1	(1)
		(Total 8 marks)	

Question Number	Question		
6931_01_Q04ai	The fan consists of a blade which is rotated by an electric motor, as shown below in Figure 3. State <u>one</u> material that would be suitable for the blade and provide <u>four</u> reasons for choosing the material.		
	Answer	Part Mark	Total Mark
	<p>Material : Any material from the following:</p> <ul style="list-style-type: none"> • Polycarbonate • Nylon • HDPE • Aluminium alloy (but not aluminium) • Steel 	1x1	(1)
	<p>Reasons: Any four reasons from the following:</p> <ul style="list-style-type: none"> • Insulating • Low weight (allow follow on for aluminium) • Easy to shape • Low cost • Similar <p><i>(If alloy allow suitable process eg casting, stamping)</i></p>	4x1	(4)

Question Number	Question		
6931_01_Q04aii	State a method of mass production that would be used to manufacture the blade from the material you have chosen, and explain <u>four</u> key stages of the manufacturing process.		
	Answer	Part Mark	Total Mark
	Method of mass production: Injection moulding	1	(1)
	Key stages of the method (injection moulding): Any four from the following: <ul style="list-style-type: none"> • material is heated • injected under pressure into the mould • released from mould • clean or quality check <i>(allow die casting for aluminium alloy or pressing for steel)</i>	4x1	(4)
Question Number	Question		
6931_01_Q04b	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.		
	Answer	Part Mark	Total Mark
	A clear sketch to show an appropriate fixing method, giving sufficient information for a working item to be constructed. As an example, marks can be awarded for each of the following points: (any of the points may simply be shown diagrammatically)		(6)



Typical features that can be shown or referred to:

- Central hole through blade (1)
- Motor shaft (1)
- Tapped (1) hole (1) for grub screw
- Grub screw (1)
- Clarity of diagram (1)

Full marks for any other fixing system that would meet the required purpose and which is clearly shown, eg screw or glue (a small pilot hole is needed in this case), or interference fit or use grub screw or screw and nut(s) and washers (the blade would need a central hole through it in this case).

(Total 16 marks)

Question Number	Question		
6931_01_Q05a-b	<p>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.</p> <p>(a) The pins on the electric plug. (b) The outer covering of the electric cable.</p>		
	Answer	Part Mark	Total Mark
	<p>(a) The pins on the electric plug: Any four from the following: It must be an electrical conductor (1). Pure aluminium is too soft (1) and the steel would rust (1). Brass (1) is hard, and won't wear down (1) or has high tensile strength (1).</p>	4x1	(4)
	<p>(b) The outer covering of the electric cable: Any four of the following: The covering must be an electrical insulator (1). ABS is too rigid (1), but PVC (1) is the most appropriate as it is flexible (1) and available in a range of colours (1), lower cost (1).</p>	4x1	(4)
		(Total 8 marks)	

Question Number	Question		
6931_01_Q06a	Give <u>one</u> example of a thermoplastic polymer and <u>one</u> example of a thermosetting polymer.		
	Answer	Part Mark	Total Mark
	Any one from the following:		
	Thermoplastic: <ul style="list-style-type: none"> • Acrylic • Nylon • PVC • HIPS 	1	(1)
	Thermosetting: <ul style="list-style-type: none"> • Bakelite • Melamine • Epoxy resins 	1	(1)

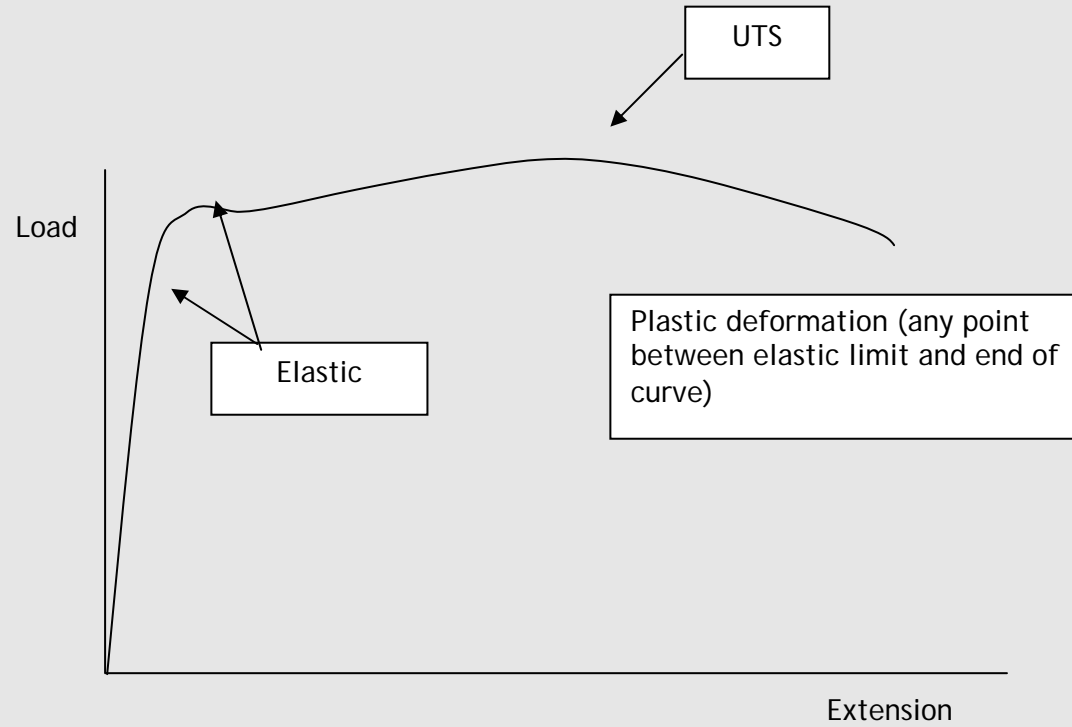
Question Number	Question		
6931_01_Q06c	Describe the differences in <u>properties</u> between thermoplastic and thermosetting polymers.		
	Answer	Part Mark	Total Mark
	Thermoplastics soften (1) when reheated (1) but thermosets can never be softened by reheating (1), and tend to be more rigid/brittle (1)	4x1	(4)
		(Total 10 marks)	
Question Number	Question		
6931_01_Q07ai-iii	A load-extension curve for low carbon steel is shown below. Indicate, using an arrow and label, the points on the curve which correspond to: (i) the UTS (ultimate tensile strength) (ii) the elastic limit (iii) the area of plastic deformation		

Answer

Part
Mark

Total
Mark

1 mark for each correct arrow. (The plastic region can be anywhere on the top part of the graph)



1
1
1

(3)

Question Number	Question		
6931_01_Q07bi-ii	Describe what is meant by: (i) the elastic limit (ii) plastic deformation		
	Answer	Part Mark	Total Mark
	(i) The elastic limit is maximum point at which the stretched specimen will return to its original length, once the load is removed. (or limit of linear part of curve).	2x1	(2)
	(ii) Plastic deformation occurs when the specimen is stretched beyond its elastic limit. After this, it remains permanently stretched when the load is removed.	2x1	(2)
Question Number	Question		
6931_01_Q07ci-ii	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 (ii) the stress		
	Answer	Part Mark	Total Mark
	The strain = extension/original length (1)	1	(1)
	= $0.2/60$ (2)	2x1	(2)
	= 3.33×10^{-3} (1) for number (1) for no unit shown	2x1	(2)
	The stress = Force/Area (1)	1	(1)

= 3000/20 x 10 ⁻⁶ (2)	2x1	(2)
= 1.5 x 10 ⁸ N m ⁻² (1) for number (1) for unit	2x1	(2)

Formula must be correct to allow marks for working.

(Total 17 marks)

Question Number	Question	Part Mark	Total Mark
6931_01_Q08a	The case for the hairdryer is made in two halves, as shown. The two halves are subsequently joined together. Give <u>three</u> reasons for making the casing in two sections, rather than as one single piece.		
	Answer		
	Any three from the following: <ul style="list-style-type: none"> • It is made in two pieces so that the internal parts can be inserted first, then the two pieces joined together (1) • This means it can be disassembled for repairs (1) • It is also easier to make the mould from two pieces rather than a complicated single piece (1) • A mould is cheaper and/or simpler (1) 	3x1	(3)
Question Number	Question	Part Mark	Total Mark
6931_01_Q08b	Describe how the two halves of the casing can be joined together to allow for maintenance and repair.		
	Answer		
	<ul style="list-style-type: none"> • Screws could be used (1) • One half of the casing would have holes all the way through for the screws (1) • The other half would have four smaller 'blind' holes to accept the screws (1), nuts & bolts <i>(accept any other suitable method, but not gluing).</i>	3x1	(3)

Question Number	Question		
6931_01_Q08ci	<p>In deciding which material to use for the casing, two materials are considered: stainless steel and ABS (acrylonitrile butadiene styrene).</p> <p>Discuss the relative advantages and disadvantages of these materials in this application.</p>		
	Answer	Part Mark	Total Mark
	<p>Advantages and disadvantages. Any eight suitable points from the following:</p> <ul style="list-style-type: none"> • Stainless steel is an electrical conductor and could make the product less safe to use (1), OR ABS is an insulator and so would be safer especially with wet hands, etc (1) • Stainless steel would look attractive (1) and be more robust (1) • ABS would be lighter in weight than stainless steel (1) • Stainless is difficult to form into complex shapes. (1) • Neither ABS or stainless steel need surface finishing (1) • ABS has the advantage that it can be coloured. (1) • ABS can be formed into complex shapes by injection moulding (1) • ABS is lower cost (1) • ABS has lower thermal conductivity, which is better for the handle of the hairdryer (1) 	8x1	(8)

Question Number	Question		
6931_01_Q08cii	Select the one which is best for the casing, briefly stating <u>two</u> reasons for your choice.		
	Answer	Part Mark	Total Mark
	Best final choice: ABS (1) Reason: any two from the following:	1x1	(1)
	<ul style="list-style-type: none"> • safety (insulator) or easiest to shape • manufacture • lowest cost • can be multi-coloured <i>(allow SS, but only if commercial use of the dryer is referred to)</i>	2x1	(2)
		(Total 17 marks)	
		TOTAL FOR PAPER: 90 MARKS	