

Mark Scheme Summer 2009

GCE

GCE Engineering (8731/9731)

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2 (a)	<table border="1"> <thead> <tr> <th>Class of material</th> <th>Specific material</th> <th>Significant property of material</th> </tr> </thead> <tbody> <tr> <td>Non-ferrous alloy</td> <td>Duralumin Brass</td> <td>Age hardens Corrosion resistant</td> </tr> <tr> <td>Thermoplastic polymer</td> <td>Acrylic Polyamide</td> <td>Brittle Self lubricating</td> </tr> <tr> <td>Thermosetting polymer</td> <td>Urea formaldehyde Polyester resin</td> <td>Heat resistant Hard</td> </tr> <tr> <td>Adhesive</td> <td>Epoxy resin Cyanocrylate</td> <td>Bonds dissimilar materials Very high bond strength</td> </tr> </tbody> </table> <p>Do not accept 'light', 'strong', 'rust'.</p> <p>1 mark for each correct material, 1 mark for each appropriate property.</p>	Class of material	Specific material	Significant property of material	Non-ferrous alloy	Duralumin Brass	Age hardens Corrosion resistant	Thermoplastic polymer	Acrylic Polyamide	Brittle Self lubricating	Thermosetting polymer	Urea formaldehyde Polyester resin	Heat resistant Hard	Adhesive	Epoxy resin Cyanocrylate	Bonds dissimilar materials Very high bond strength	(8)
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Question Number	Answer	Mark
2 (b)(i)	Ferrous Ferrous metal (only acceptable answers)	(1)

Question Number	Answer	Mark
2 (b)(ii)	Any two from: <ul style="list-style-type: none"> • It is heavy/dense(1) • Can be easily machined for fixing to washing machine (1) • Can be cast into complex shapes (1) 	(2)

Question Number	Answer	Mark
3 (a)	Molten metal (1) is poured into a chamber (1) an injection piston is pushed forward (1) usually hydraulically (1) which forces the metal (1) into a steel mould (1) finished to a high standard (1). The casting is cooled quickly and solidifies (1). The casting is ejected/removed (1) final finishing is carried out (1). Any six appropriate points	(6)

Question Number	Answer	Mark
3 (b)	<ul style="list-style-type: none"> • A better surface finish is produced (1) so finer details can be achieved (1) • Less time is require for each cycle (1) so more components can be produced in a shorter time (1) • Better mechanical properties can be achieved (1) due to faster cooling rate (1) • Thinner walled components can be produced (1) due to molten metal being forced into cavities under high pressure (1) • More complex shapes can be produced (1) due to the accuracy and finish of the dies (1) • Little or no machining is required (1) so mouldings are more cost effective (1) • Thousands of identical castings can be produced from the same mould (1) instead of having to re-pack individual sand moulding flasks (1) <p>Any two advantages supported by linked points</p>	(4)

Question Number	Answer	Mark
4 (a)(i)	Copper	(1)

Question Number	Answer	Mark
4 (a)(ii)	<ul style="list-style-type: none"> • Low electrical resistivity (1) which will allow current to flow effectively (1) • Ductile(1) which means it can be stretched into thin wire with (1) with relatively good tensile strength (1) • Corrosion resistant(1) which means it will have a long service life (1) <p>Any appropriate answer (up to 2 marks if justification for wrong material is given)</p>	(2)

Question Number	Answer	Mark
4 (b)(i)	Borosilicate glass	(1)

Question Number	Answer	Mark
4 (b)(ii)	<ul style="list-style-type: none"> • Low thermal conductivity(1), won't get hot (1) • Transparent(1), can see washing in progress (1) • Can be cast/moulded into shapes(1) to fit machine(1) • Corrosion resistant (1) therefore longer lasting (1) <p>Any appropriate answer (up to 2 marks if justification for wrong material is given)</p>	(2)

Question Number	Answer	Mark
4 (c)(i)	Urea formaldehyde (UF)	(1)

Question Number	Answer	Mark
4 (c)(ii)	<ul style="list-style-type: none"> • Good impact strength (1), to give durability (1) • Low cost (1), cheap to replace (1) • Easily moulded (1), make complex shapes (1) • Easily coloured (1), hot and cold water/aesthetically pleasing (1) <p>Any appropriate answer (up to 2 marks if justification for wrong material is given)</p>	(2)

Question Number	Answer	Mark
5 (a)	To harden steel, it must be heated (1) to its critical temperature/900°/red (1) and then quenched (1).	(3)

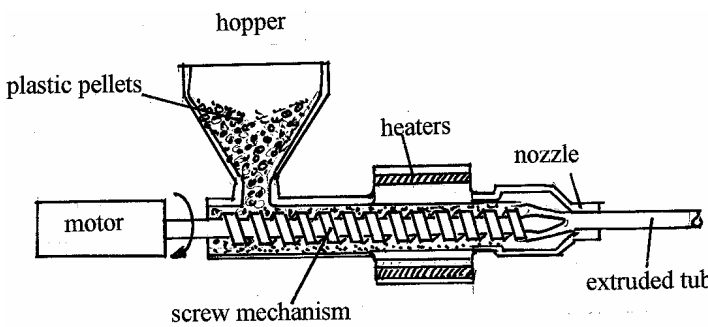
Question Number	Answer	Mark
5 (b)	To temper steel it must be heated to a controlled temperature/appropriate oxide colour (1) - depending on the product (1) then quenched (1).	(3)

Question Number	Answer	Mark
5 (c)(i)	Purpose of normalising is to remove stresses from steel	(1)

Question Number	Answer	Mark
5 (c)(ii)	This requires it to be heated to critical temperature (1) then cooled in air/cooled slowly (1)	(2)

Question Number	Answer	Mark
6 (a)(i)	<ul style="list-style-type: none"> • In the greenhouse window, SMA is coiled into a spring shape (or similar) (1) • Opens and closes a hinged window in response to temperature change (1) • Alloy changes length/shape at a specific temperature (1) • Held in shape while the temperature is maintained (1) • Returns to normal length/shape when the temperature is removed/reduced (1) <p>Any three appropriate points</p>	(3)

Question Number	Answer	Mark
6 (a)(ii)	<ul style="list-style-type: none"> • In insulating soldered joints, heat shrink sleeving is slid into position (1) • Heat is applied to the heat shrink sleeving (1) • The sleeving shrinks (1) • To cover the joint and offer electrical insulation (1) <p>Any three appropriate points</p>	(3)

Question Number	Answer	Mark
6 (b)	<p>Plastic pellets are poured into the hopper (1) a motor turns (1) operating a screw mechanism (1) carrying the pellets to heaters (1) where the pellets are melted (1) The molten plastic is forced out of the nozzle (1) shaped to produce a specific profile (1) and is cooled (1) to produce a continuous extruded shape (1)</p> <p>Any five appropriate points accompanied by a relevant sketch</p>  <p>A well labelled, clear sketch can be credited with full marks if the process is explained graphically.</p>	(5)

Question Number	Answer	Mark
7 (a)(i)	<ul style="list-style-type: none"> • Metals have higher tensile strength (1) so can support higher loads (1) • Thinner section than plastic (1) less space required inside washing machine cases (1) • More heat resistant (1) 	(2)

Question Number	Answer	Mark
7 (a)(ii)	<ul style="list-style-type: none"> • Metals have a higher density (1), so more power (1) is needed to spin the drum. • They are more costly to produce (1) therefore cost to consumer higher (1) • Fixing brackets/lugs need to be attached separately (1) rather than moulded (1) • Metal may corrode (1) 	(2)

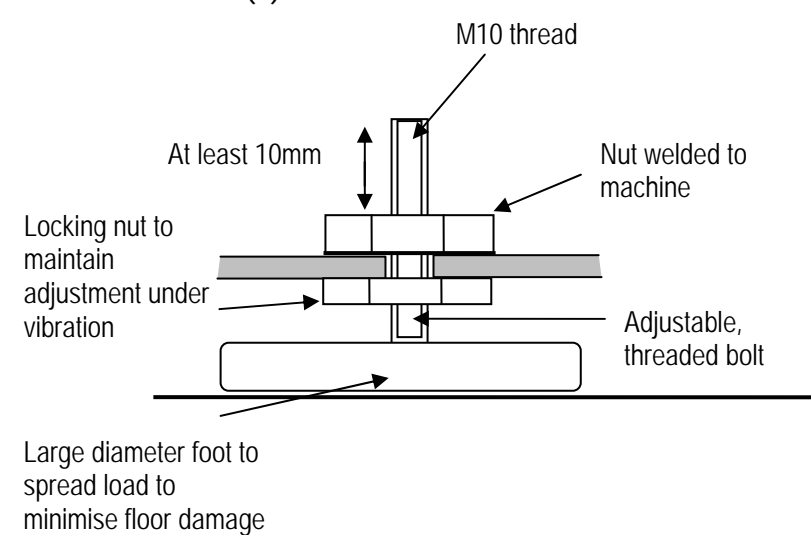
Question Number	Answer	Mark
7 (b)(i)	Stainless steel	(1)

Question Number	Answer	Mark
7 (b)(ii)	<p>Stainless is best because,</p> <ul style="list-style-type: none"> • unlike the other steels, it will not corrode/keeps its surface finish (1) • It has a much higher tensile strength than aluminium (1) • Thinner sections possible (1) <p>Any appropriate answer (up to 2 marks if justification for wrong material is given)</p>	(2)

Question Number	Answer	Mark
7 (c)(i)	Rubber	(1)

Question Number	Answer	Mark
7 (c)(ii)	<ul style="list-style-type: none"> • tough (1) • flexible (1) • resists slippage (1) • durable (1) • elastic (1) <p>Any appropriate answer (up to 2 marks if justification for wrong material is given)</p>	(2)

Question Number	Answer	Mark
8 (a)	The floor may be uneven (1), without levelling feet the machine would rock in use (1)	(2)

Question Number	Answer	Mark
8 (b)	<p>Marks will be awarded for design features relating to those below.</p> <ul style="list-style-type: none"> • Method of fixing the device to the base of the washing machine (2) <i>fully workable</i> (2) <i>partially workable</i> (1) • Method of adjusting the feet. (2) <i>fully workable</i> (2) <i>partially workable</i> (1) • Method of limiting the effects of vibration to the adjustment (2) <i>fully workable</i> (2) <i>partially workable</i> (1) • Method of protecting the floor from damage from the feet (2) <i>fully workable</i> (2) <i>partially workable</i> (1) • Appropriate dimension relating to hole in machine base (1) • Appropriate dimension relating to range of adjustment (1) <p>An example of an appropriate design solution is shown below.</p> <p>An adjustable bolt(1) threaded M10 (1) with more than 10mm adjustment (1) runs in a nut (1) threaded M10 (1) which is welded to the washing machine base (1). A locknut is tightened against the machine base (1) to prevent vibration from shaking the adjustment loose (1). The large diameter foot (1) is fixed to the bolt and spreads the load (1) to minimise damage to the floor (1). M10 matches the hole in the machine base (1).</p> 	(10)

Question Number	Answer	Mark
9 (a)(i)	The ability of a material to be cold drawn into thinner diameter cross section(1) without rupture (1)	(2)

Question Number	Answer	Mark
9 (a)(ii)	The ability of a material to be permanently deformed (1) without rupture or cracking (1)	(2)

Question Number	Answer	Mark
9 (a)(iii)	The ability of a material to withstand sudden shocks or blows(1) without fracture(1)	(2)

Question Number	Answer	
9 (b)	<p>Example of an appropriate response is shown below.</p> <p>Mild steel is cheap(1) but needs a surface finish to protect from corrosion(1).</p> <p>Stainless steel will not need a surface finish (1) and is aesthetically pleasing in a kitchen (1) but it is expensive (1) and more difficult to form (1).</p> <p>Polycarbonate can be self coloured (1), is cheap to produce through injection moulding (1) and is an electrically safe insulator (1), but it has comparatively low strength (tensile, shear and compressive) (1) so could be damaged easily(1)</p>	
Level	Mark	Descriptor
	0	No rewardable material
1	1-2	The candidate identifies one or two advantages/disadvantages with no development. Shows limited understanding of advantages/disadvantages. The candidate uses everyday language and the response lacks clarity and organisation.
2	3-4	The candidate identifies some advantages/disadvantages with associated developments showing some understanding of advantages/disadvantages. The candidate uses some specialist terms and the response shows some focus and organisation.
3	5-6	The candidate identifies a range of advantages/disadvantages with associated developments showing a detailed understanding of advantages/disadvantages. The candidate uses appropriate specialist terms consistently and the response shows good focus and organisation.

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