



**General Certificate of Education (A-level)  
January 2013**

**Design and Technology:  
Product Design**

**PROD1**

**(Specification 2550)**

**Unit 1: Materials, Components and Application**

**Final**

***Mark Scheme***

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**COMPONENT: PROD1**

**NB** This mark scheme is intended as a guide to the type of answer expected but is not intended to be exhaustive or prescriptive. If candidates offer other answers which are equally valid they must be given full credit.  
Many responses at this level are assessed according to the quality of the work rather than the number of points included. The following level descriptors are intended to be a guide when assessing the quality of a candidate's response.

<b>(low mark range)</b>
The candidate has a basic but possibly confused grasp of the issues. Few correct examples are given to illustrate points made. This candidate does not have a clear idea of what s/he is writing about.
<b>(mid mark range)</b>
The candidate has some knowledge but there will be less clarity of understanding. Some correct examples given to illustrate points made. This candidate knows what s/he is writing about but is confused in part.
<b>(high mark range)</b>
The candidate has a thorough understanding of the issues and has provided relevant examples to support the knowledge shown. This candidate knows what s/he is writing about and provides clear evidence of understanding.

**JANUARY 2013 SERIES**

**COMPONENT: PROD1**

**COMPONENT NAME: Materials, Components and Application**

**Section A**

Question	Part	Sub Part	Marking Guidance	Mark	Comments
1	a		<p>The use of computers to control machines</p> <p>Plus explanation:</p> <p>E.g. Computer Numerical Control refers to the use of computer code to control the movement of machine tools, robots, etc.</p> <p>Or</p> <p>Or the use of a computer programme/ G &amp; M codes plus data to control manufacturing equipment</p>	2	<p>1 mark for definition + 1 mark for explanation</p> <p>If specific CNC machine named = 2 marks</p>
1	b		<p>E.g. Application: the control of milling machine</p> <p>Reasons:</p> <p>Enables the repeatability of processes to a much higher level of accuracy than is possible by manual machining.</p> <p>CNC milling files can be converted directly from CAD drawings</p> <p>CNC operated milling would be much quicker than operating a milling machine manually.</p> <p>CNC milling machine can cut more complex profiles than would be possible by hand</p> <p>CNC machines are often fully enclosed so are much safer than manually operated machines.</p> <p><b>Other applications:</b></p> <p>CNC laser cutter/engraver</p> <p>CNC router</p> <p>CNC drill</p> <p>CNC flame cutter</p> <p>CNC control of robots for spot welding, spray painting, etc.</p> <p>CNC rapid prototype for model making.</p> <p>CNC probe or laser measuring</p>	2	<p>1 mark for application</p> <p>+ 1 mark for valid reason</p> <p>If application is a process award 1 mark. Note, the reasons must relate to CNC.</p> <p>If no application given award zero.</p>

Question	Part	Sub Part	Marking Guidance	Mark	Comments
2			<p>E.g. Product: Dining table top</p> <p>Reasons:                      Accept references to aeroply, marine ply, flexi ply etc.                      Cheaper = zero                      Cheaper than natural timber or named timber e.g. oak= 1mark.</p> <p>Plywood is available in long, wide boards so it will be easy to create a large surface area such as a table top.                      Plywood is a stable material so it doesn't usually warp or twist like natural timber might.                      Plywood is a very flat material that is perfect for applying a high quality surface wood veneer on.</p> <p><b>Other example applications:</b>                      Wardrobe backs                      Shed roofs                      Exterior projects e.g. planters, play equipment                      Boat building</p>	3	<p>1 mark for appropriate product</p> <p>2 x 1 mark for valid reasons.</p> <p>Strong= 0                      Strong with specific reason = 1</p>

Question	Part	Sub Part	Marking Guidance	Mark	Comments								
3			<table border="1"> <tr> <td>Cutting sheet acrylic into 100mm squares</td> <td>Reducing the diameter of an aluminium bar</td> <td>Cutting a 10mm slot into a 50 x 50mm mild steel block</td> <td>Annealing a piece of copper sheet</td> </tr> <tr> <td><b>D</b></td> <td><b>A</b></td> <td><b>B</b></td> <td><b>C</b></td> </tr> </table>	Cutting sheet acrylic into 100mm squares	Reducing the diameter of an aluminium bar	Cutting a 10mm slot into a 50 x 50mm mild steel block	Annealing a piece of copper sheet	<b>D</b>	<b>A</b>	<b>B</b>	<b>C</b>	4	
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<b>D</b>	<b>A</b>	<b>B</b>	<b>C</b>										

Question	Part	Sub Part	Marking Guidance	Mark	Comments
4	a		<p>E.g. Figure 1 Sanding low hazard materials                      Accept using an airbrush                      Accept spray painting with low hazardous paints</p> <p>Figure 2 Handling hot materials or materials hazardous to skin                      Accept welding                      Accept casting                      Accept using a hot glue gun</p> <p>1 mark per specific process</p>	2 x 1 mark	1 mark per specific process.

4	b		<p>Figure 1- Dust masks are suitable for use where the exposure levels are low or the material being sanded is not hazardous such as softwood.</p> <p>Figure 2- Protective gloves must be worn where there is burn risk from handling hot items such as when casting or welding.</p>	2 x 2 marks	<p><b>Breakdown:</b>                  Basic explanation with some confused points. Possibly only one of the signs explained. (0-2 marks)</p> <p>Better explanation with both signs fully explained (3-4 marks)</p>
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Question	Part	Sub Part	Marking Guidance	Mark	Comments
5			<p>UV hardening adhesive will not bond until exposed to light from a UV light source. This means it can be handled more safely as Superglue bonds skin instantly. Excess UV hardening adhesives can be wiped up safely. UV hardening adhesive does not give off toxic fumes.</p>	3	<p><b>Breakdown:</b>                  Simple answer. Little reference to the UV qualities and why this is safer. (0-1 mark)</p> <p>Fuller answer. Understands action of UV and why this is safer. (2-3 marks)</p>

**Section B**

Question	Part	Sub Part	Marking Guidance	Mark	Comments
6	a		<p>E.g. Concrete is a suitable material because it can be cast into large pieces to create the design of the bench.                      Concrete is weather resistant which is needed because the bench would be used outdoors.                      Concrete has excellent compressive strength which makes it ideal to take the weight of a number of people sitting on it.                      Concrete is a much cheaper alternative than using natural stone because the raw materials are readily available.                      Concrete can be reinforced with steel bars or mesh to reduce the quantity of concrete required and maintain compressive/tensile strength                      Concrete can be colored with a pigment to make it look like natural stone                      Concrete can be cast in moulds on site which might be easier than transporting a heavy prefabricated item.                      Components can be cast inside the concrete e.g. steel bolts and fixings to join the bench to the floor, etc</p>	6	<p>1 – 2 marks per reason.                      Award second mark for explanation.</p> <p>Max 3 marks for a simple list of properties without explanation.</p> <p>Do not accept 'easy to shape/mould'</p> <p>Strong=0 marks                      Strong to hold weight of people=1 mark</p> <p>Durable=1mark</p>
6	b		<p>Expect reference to:</p> <ul style="list-style-type: none"> <li>• Manufacture of suitable wooden or GRP moulds.</li> <li>• Mixture of a batch of the constituent parts: sand, Portland cement, aggregate, water.</li> <li>• Pouring the concrete into prepared moulds.</li> <li>• Setting time.</li> <li>• Smoothing/removal of defects before completely dry</li> </ul>	8	<p><b>Breakdown:</b></p> <p>Very simple description.                      Diagrams may be unclear. There may be several omissions.                      (0-3 marks)</p> <p>Better description.                      Diagrams are of better quality.                      Only minor omissions.                      (4-6 marks)</p> <p>Full answer. Clear diagrams. All points included                      (7-8 marks)</p>

6	c		<ul style="list-style-type: none"> <li>• Making the concrete thicker</li> <li>• Modifying with an additional centre leg</li> <li>• Using a mild steel mesh (Rebar)</li> <li>• Or using mild steel bars/pre-tensioning the concrete</li> <li>• Or the installation of a mild steel cross member</li> </ul>	6	<p><b>Breakdown:</b>                  Method may be basic (e.g. making it thicker) or diagram may be inappropriate. Diagram unclear. (0-2 marks)</p> <p>Method appropriate with some explanation, diagram mostly clear. (3-4 marks)</p> <p>Method correct explained in some detail. Diagram is clear. (5-6 marks)</p>
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Question	Part	Sub Part	Marking Guidance	Mark	Comments
7	a	i	<p>Nickel plated steel sheet- Pencil case</p> <p>e.g.</p> <ul style="list-style-type: none"> <li>• Nickel plated steel is a malleable material. This means it can be press formed into the required shape without tearing.</li> <li>• Nickel plated mild steel is ductile. This means it can be press formed into the required shape.</li> <li>• Nickel plated mild steel sheet is tough and will withstand minor impacts, helping to maintain product aesthetics.</li> <li>• Nickel plated steel will not corrode which would spoil the aesthetic appearance of the pencil case.</li> <li>• Nickel plated steel is less expensive than alternatives such as stainless steel or aluminium. Accept references to recycling and embossing.</li> </ul> <p>Lightweight=0 marks                      Can be printed on = 1 mark                      Reference to flexography = 2 marks</p>	8	<p><b>Breakdown:</b></p> <p>1 – 2 marks per reason. Award second mark for explanation.</p> <p>Max 4 marks for a simple list of properties without explanation.</p>

7	a	ii	<p>High impact polystyrene- disposable razor</p> <p>e.g.</p> <ul style="list-style-type: none"> <li>• HIPS is a thermoplastic which can be injection moulded. This is needed because a disposable razor would be too complex to make in any other way.</li> <li>• HIPS is not affected by water or any shaving products</li> <li>• HIPS will incinerate to release embodied energy (most consumer waste is incinerated).</li> <li>• HIPS can be made from recycled sources. This is important in a product that will have a short lifecycle.</li> <li>• HIPS like all polymers can be coloured with a pigment to ensure a good aesthetic appearance.</li> <li>• HIPS can be overmoulded with TPE or LSR for improved grip</li> </ul> <p>Accept references to lightweight and hygienic.          Do not accept recycling as items such as razors should be incinerated due to safety/hygiene issues.</p>	8	<p><b>Breakdown:</b></p> <p>1 – 2 marks per reason. Award second mark for explanation.</p> <p>Max 4 marks for a simple list of properties without explanation.</p>
7	b		<p>E.g. Cellulose acetate is transparent. This enables the contents of the packaging to be seen.</p> <p>Cellulose acetate is a biodegradable polymer. This is useful in a product that has a short lifecycle and will be disposed of quickly.</p> <p>Cellulose acetate can be heat sealed to make an air tight closure, keeping food fresh.</p> <p>Cellulose acetate can be calendared to make a thin film which is used in food covering</p> <p>Cellulose acetate is completely food safe which is therefore safe to use in food packaging</p> <p>Cellulose acetate is impermeable, and therefore will be air tight and won't let contents leak out.</p>	4	<p>1 mark for property</p> <p>1 mark for explanation.</p> <p>Max 2 marks for a simple list without explanation</p>

**Section C**

Question	Part	Sub Part	Marking Guidance	Mark	Comments
8	a	i	E.g. Plywood Accept MDF, chipboard, blockboard, lamin board, conti board, NOT hardboard	1	
8	a	ii	E.g.  Plywood/MDF can be easily cut with a jig-saw to produce the curves in the design. Plywood/MDF is available in exterior grade, when painted will last for years. Plywood/MDF is widely available. This helps to keep the cost of the product to an acceptable level. Plywood/MDF has a good, flat surface that makes it ideal for painting. Plywood/MDF is available in thicknesses such as 12 or 15mm which makes it substantial for a product that will need to last.  Accept references to no grain problems etc. Do not accept 'cheap'. Cheaper than solid timber = 1 mark Cheap compared to a named timber = 2 marks	6	<b>Breakdown:</b>  1-2 marks per reason. Award second mark for explanation.  Max. 3 marks for a simple list of properties without explanation.  If no answer or incorrect answer in part a(i), credit relevant properties in a(ii). Do not double penalise.
8	a	iii	E.g. Acrylic sheet is available in transparent form which makes it perfect for making a box where the user likes to see coins dropping into it. It allows staff to see how much money has been collected and when it is full. Acrylic sheet is available in thicknesses such as 10mm which would make it tough, resistant to impacts or vandalism. Acrylic is available in sheet form which is ideal to make the box as shown in the photo	2 x 2 marks	<b>Breakdown:</b> 1-2 marks per reason. Award second mark for explanation.  Max 3 marks for a simple list of properties without explanation

8	b	i	<p>Expect reference to:                  Producing a template from card                  Marking out the plywood/MDF using the template.                  Cutting the plywood using a jig-saw                  Using a rasp file/spoke shave and glass paper to smooth/round edges.                  Drilling the cross members and side panels.                  Using wood screws, dowel or KD fittings.                  Using a router to cut slots into the plywood for acrylic sides                  Cutting the acrylic using a bandsaw &amp; filing</p> <p>Accept reference to cutting plywood parts using a CNC router (expect ref to CAD stages, speeds, bullnose cutter, for high mark band)                  Accept reference to cutting plywood parts using a CNC laser cutter (expect ref to CAD stages, speed and power settings.</p>	9	<p><b>Breakdown:</b>                  Method may not be appropriate.                  Diagrams unclear.                    (0-3 marks)</p> <p>Method could be appropriate but some detail missing, diagrams mostly clear. (4-6 marks)</p> <p>Method correct.                  Good detail to answer. Diagram is clear.                  (7-9 marks)</p>
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8	b	ii	<p>E.g.</p> <p>Fabrication is suitable because for a one-off job it is not worth the cost of tooling up for processes involving forming or redistribution.</p> <p>Fabrication can be done with simple hand/power tools available in most workshops</p> <p>Fabrication is suitable because it is quicker than making moulds for laminating with GRP or similar</p> <p>It can be assembled on site if required (large product, will be easier to fit through doors in parts/flat-packed)</p> <p>It is made from different parts, not as a one piece mould (to allow for a clear central collection box and solid colour sides), so needs to be assembled together.</p> <p>Do not credit, quick/cheap process unless fully explained.</p>	4	<p><b>Breakdown:</b></p> <p>1-2 marks per reason. Award second mark for explanation.</p>
8	c		<p>E.g.</p> <ul style="list-style-type: none"> <li>• Sanding the timber with the grain</li> <li>• Use of different grades of glass paper</li> <li>• Cleaning with white spirit and allowing to dry</li> <li>• Application of a primer</li> <li>• Drying time</li> <li>• Use of a roller or air gun to apply paint. Possible use of a stencil for the pattern. Possible use of a sponge or dry brush for pattern.</li> <li>• Specific named paints – acrylic based, quick drying egg-shell, exterior gloss, etc.</li> <li>• Possible re-application of top coats after drying</li> <li>• Possible application of a lacquer</li> </ul>	4	<p><b>Breakdown:</b></p> <p>Non-specific 'paint' described. Application by brush.(award up to 2 marks if diagrams are clear) (0- 2 marks)</p> <p>Paint is specific Application method is suitable. Most details present. (3-4 marks)</p>

8	d	<p>Answers might include:</p> <p><b>Materials/Manufacture:</b></p> <p>The use of materials such as exterior grade plywood, marine plywood, GRP, thick polymer sheets e.g. HDPE.          Cutting all the parts that are the same size at the same time.          The use of templates, jigs, etc to aid production          Working in teams/some division of labour.          Use of KD fittings.          Possible use of a CNC router/laser to cut out the parts.          Methods to speed up finishing e.g. polymer sheet will have a base colour. Stencil to apply paint with a sponge for pattern, or screen print.</p> <p><b>Interactive/fun element:</b></p> <p>The use of a 'coin dozer' mechanism          The use of a maze or coin run          Audio/visual effects e.g. flashing lights, animal noises, 'thank-you'          Use of an LCD screen and video with animal welfare film activated by coin donation.</p> <p><b>N.B.</b> Candidate cannot re-design a new product. The proposal should follow the same form as the original giraffe.          If product is a re-design award credit only for materials.</p>	12	<p><b>Breakdown</b></p> <p>Basic development.          Specific material named. Making process may not be suitable for batch production.          Interactive/fun element not given much consideration if any.          (0- 4 marks)</p> <p>Good development with specific suitable material named. Making process will be suitable for batch production with some details given to justify selection. Some consideration given to the interactive element. (5-8 marks)</p> <p>Full development taking account of all points of the specification.          Material named.          Batch production method described in some detail.          Fun element suitable and described with appropriate notes and diagrams.          (9-12 marks)</p>
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