



**General Certificate of Education (A-level)  
January 2011**

**Design and Technology:  
Product Design**

**PROD1**

**(Specification 2550)**

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

**Final**

***Mark Scheme***

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Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Set and published by the Assessment and Qualifications Alliance.

**COMPONENT NUMBER: 2550**

**COMPONENT NAME: PROD1**

**STATUS: Post-Standardising**

**DATE: 26-01-2011**

**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 2011 SERIES

COMPONENT NUMBER: PROD1

COMPONENT NAME: Materials, Components and Application

STATUS: Post - Standardising

Question	Part	Sub Part	Marking Guidance	Mark	Comments
1	a	i	Shape Memory Alloy (SMA), Nitinol, Photochromic/Thermochromic/Phosphorescent Pigment, smart grease, smart fluid, piezoelectric devices, Polymorph, Hydromorph, Memoflex.	1	
1	a	ii	Product : e.g. Thermochromic pigment used in thermometers  Reason for use: e.g. changes colour in response to temperature change. This can be used to indicate temperature ranges on a thermometer strip. e.g. much safer to use than mercury thermometers	4	If no product named = 0 marks. 1-2 marks per relevant point. 2 marks where point is explained or further detail given. If no material given in ai, award zero marks.
1	b	i	e.g. Carbon Fibre Reinforced Plastic (Accept carbon fibre) or GRP (Glass reinforced plastic / fibre glass)	1	
1	b	ii	e.g. Carbon fibre racing car component  Reason for use 1. Lightweight which is important to reduce fuel consumption 2. CRFP can be moulded into a variety of shapes using lay-up techniques. Required for complex shaping of body parts  Can be printed/painted for company logos etc. CFRP Can be injection moulded.	4	If no product = 0 marks. Incorrect product for material named = 0 marks. If material in 1bi is incorrect award marks in 1bii for correct properties relevant to product named. If no material named in 1bi award zero.

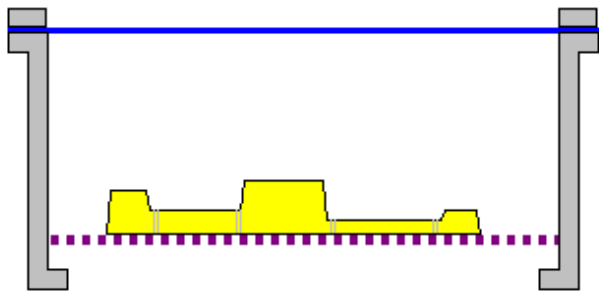
Question	Part	Sub Part	Marking Guidance				Mark	Comments
2			<b>Sheet mild steel waste bin for exterior use</b>	<b>Cast brass bathroom taps</b>	<b>Moulded polymer car bumper</b>	<b>Forged steel pliers</b>	4	One mark for each correct answer. If same answer given twice and both correct – ignore second response.
			A	C	D	B		

Question	Part	Sub Part	Marking Guidance				Mark	Comments
3	a		<b>Joining mild steel sheet to make a box</b>	<b>Joining tubular mild steel to make a frame for a chair</b>	<b>Joining 50mm x 50mm timber to make a frame section for a table</b>	<b>Joining 100 mm x 15mm timber to make a drawer</b>	4	One mark for each correct answer. If same answer given twice and both correct – ignore second response.
			C	D	A	B		
3	b		Appropriate response for fabrication method chosen. 2 marks for qualified response 1 mark for very brief response				2	

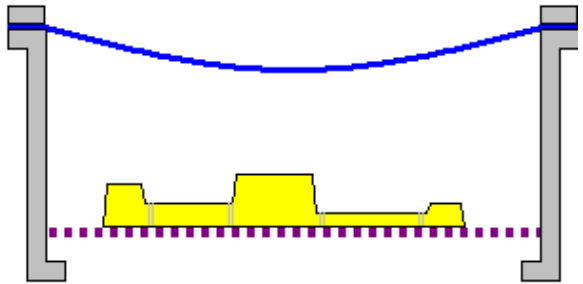
Question	Part	Sub Part	Marking Guidance	Mark	Comments
4	a	i	<p>Provides a rubber tactile surface texture for grip so it is easier to hold</p> <p>Thermoplastic which can be injection moulded (overmoulded) onto harder plastic body.</p> <p>TPE can be coloured with a pigment to highlight features e.g. power button</p>	6	<p>Accept reference to impact resistance, recyclability.</p> <p>Generic list = max 3 marks.</p>
4	a	ii	<p>PLA is biodegradable which will protect the environment if the carrier bag goes to landfill</p> <p>PLA can be calendared into a thin film which is needed to make plastic bags.</p> <p>PLA like most polymers can be printed on – required for advertising graphics</p>	6	<p>Can be plastic welded to make the seams of a bag.</p> <p>Do not award marks for recycling.</p> <p>Generic list = max 3 marks.</p>

Question	Part	Sub Part	Marking Guidance	Mark	Comments
4	a	iii	<p>The polymer lamination prevents the card from being damaged by the liquid.</p> <p>Laminated card can be recycled at specialist facilities. This protects the environment given the product has a short life cycle.</p> <p>Lamination gives the card additional strength and rigidity required to make the brick shape.</p>	6	<p>Laminated card can be printed on</p> <p>Generic list = max 3 marks</p>
4	b		<p>Expect:</p> <p>Low density polyethylene (LDPE)</p> <p>LDPE is used in carrier bags because it has good tensile strength.</p> <p>Alternatives might be: LDPE is a thermoplastic which can be recycled. It can be printed on etc.</p> <p>Accept reference to paper, card or HDPE.</p>	2	<p>1 mark for material 1 mark for reason</p>
5	a		<p>Accept – HIPS, PETE, or PLA only, LDPE, CA, Biopol</p>	1	<p>Do not accept Polystyrene, P.P, acrylic, PC, ABS or any thermoset.</p>
5	b		<p>e.g. HIPS can be vacuum or thermoformed to make into the shape needed for the package.</p> <p>e.g. HIPS is a food grade polymer and therefore the package material will not contaminate the contents.</p>	4	<p>2 marks for each reason e.g. HIPS is available in transparent form so the contents can be seen</p> <p>If incorrect material named in 5a, award marks in 5b for correct properties relevant to product use.</p>

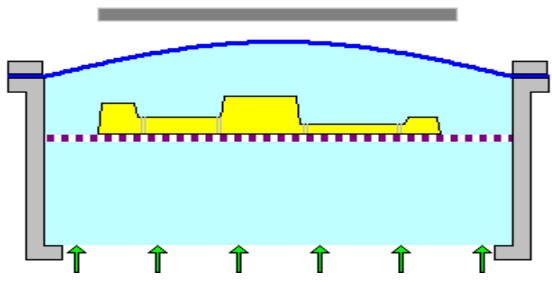
Question 5c



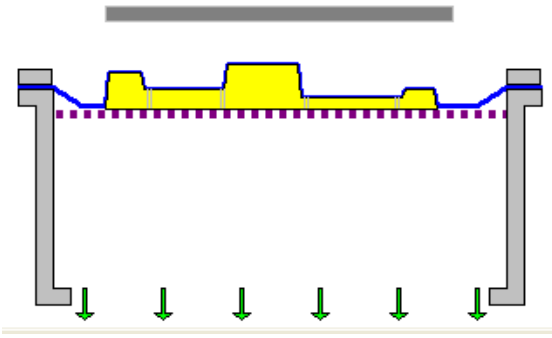
A mould is prepared and placed on the platen.  
Polymer sheet is clamped in position.



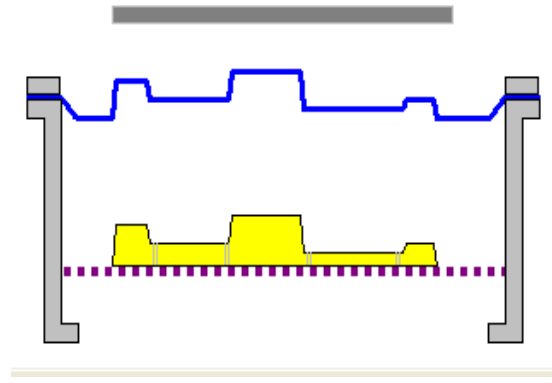
The plastic is heated until it is soft and starts to sag.



Air is blown in to stretch the softened sheet.  
The platen is raised.



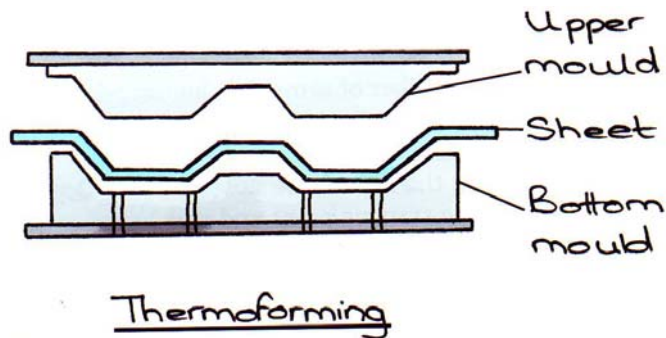
The mould is raised into the sheet and the vacuum is turned on.



Once the sheet is cooled, the platen is lowered and the moulding removed. Excess plastic is trimmed off



Accept – description of the thermoforming process:



moforming

First a 'male' former is made of the shape of package. This has a draft angle so that the moulded package can be removed afterwards.

The former is placed on the plattern or vacuum forming machine bed which is lowered.

HIPS sheet is clamped over the bed and heated until soft.

When the sheet is softened, the plattern is raised and the vacuum turned on.

In thermoforming a female former is lowered over the moulding to emboss additional detail on the package.

This might also incorporate a punch to make vent holes and cut the package out from the excess sheet.

Mark breakdown:

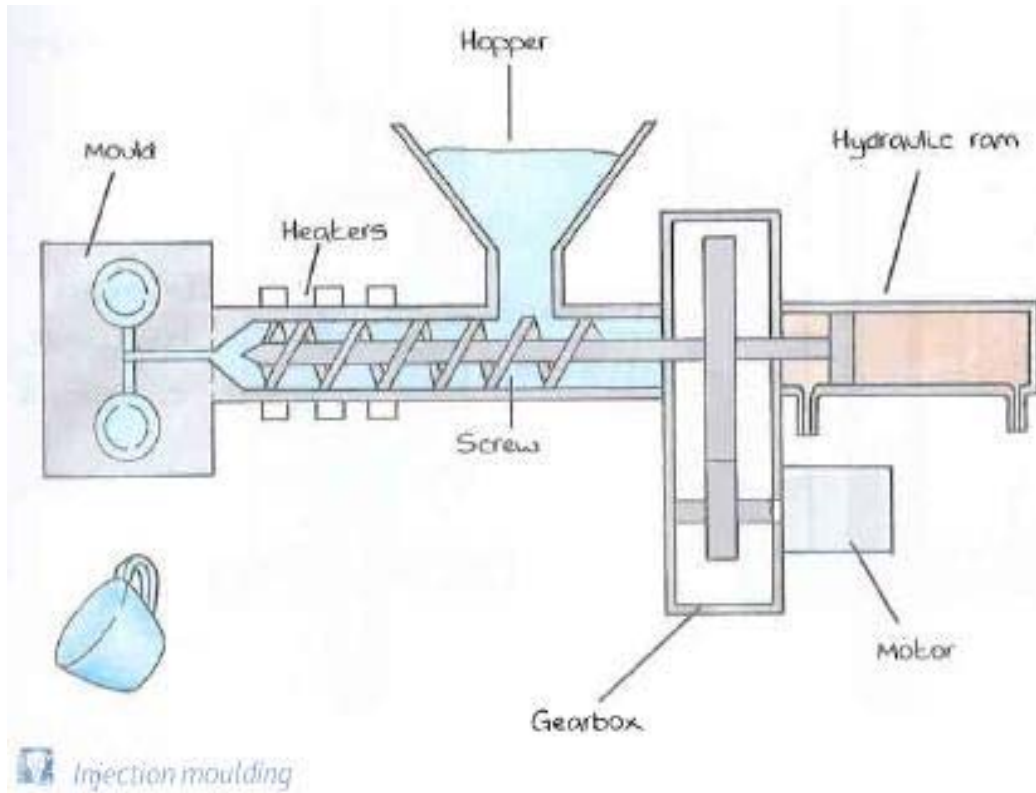
- Basic diagram with simple brief notes. Major points missed or incorrect  
0 – 3 marks
- Better diagram showing the key parts correctly labelled. Some notes describing correct process but a few points missing.  
4 – 6 marks
- Clear diagram. Almost all or all parts labelled. Sound step by step description.  
7 – 9 marks

Question	Part	Sub Part	Marking Guidance	Mark	Comments
5	d		<p>Possible answers:</p> <ul style="list-style-type: none"> <li>• Reduce the thickness of the polymer to reduce the quantity of material used.</li> <li>• Ensure the polymer is embossed with recycling information to aid identification and sorting.</li> <li>• Use a biodegradable polymer so the package would break down in landfill</li> <li>• Replace with a paper based package because this is more sustainable than using polymers</li> <li>• Replace with a re-usable/refillable container. Fruit selected from bulk containers in store.</li> </ul> <p>Accept ref to efficient mould design to reduce waste in manufacturing</p>	6	<p>Breakdown 1-2 marks per point depending upon detail/explanation.</p> <p>Award up to 2 marks for diagrams if they provide additional information.</p>

Question	Part	Sub Part	Marking Guidance	Mark	Comments
6	a	i	Any suitable thermoplastic e.g. HIPS, HDPE, LDPE, PP, Acrylic (PMMA), ABS.	1	

6	a	ii	<p>HDPE, etc, can be injection moulded into the parts shown because it is a thermoplastic.</p> <p>HDPE, etc, can be coloured with a pigment to give attractive bright colours to the pieces which makes them appealing to the target market.</p> <p>HDPE, etc, is non toxic so it is safe for children to use (children might put them in their mouth etc).</p>	6	If incorrect material given in 6ai, give credit for direct properties and application in 6aii
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Question	Part	Sub Part	Marking Guidance	Mark	Comments
6	a	iii	<p>Description:</p> <ol style="list-style-type: none"> <li>1. Polymer granules are inserted into the hopper</li> <li>2. The Archimedean screw moves the polymer along the chamber where it is heated.</li> <li>3. The polymer melts and when sufficient polymer has collected at the end of the chamber, the hydraulic ram, pushes the Archimedean screw forwards, injecting the polymer</li> <li>4. The product cools in the mould.</li> <li>5. Once set, the mould opens and ejector pins remove the product.</li> <li>6. Excess polymer (sprue and flash may be removed).</li> </ol> <p>See diagram below</p>	9	<p>Breakdown:</p> <ul style="list-style-type: none"> <li>• Simple description with little detail. Diagrams are basic with incorrect labels or incomplete parts (0-4 marks)</li> <li>• Better description using correct terminology. Diagram mostly complete and correct (5-6 marks)</li> <li>• Full description. Correct /complete diagram. Detail includes terminology e.g. ejector pins, Archimedean screw, etc. (7-9 marks)</li> </ul>



6	a	iv	<p>These products will be made in large volumes. A fast process will be needed to make the required volume within an acceptable time limit.</p> <p>The play pieces are made of complex shapes that interlock. Injection moulding is the only process that can make such small, complex parts in plastic.</p>	4	<p>Breakdown:                  1-2 marks per relevant point depending upon detail/explanation.</p>
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6	a	v	Bright colours and interesting shapes appeal to young people. The interlocking design allows for a variety of variations in assembly of the pieces adds play value.	4	Breakdown:  1 – 2 marks per point/explanation
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6	b		<p>Possible answers might include:</p> <ul style="list-style-type: none"> <li>• Change the shape to a more aesthetically pleasing/gender related form e.g. handbag/purse, teddy bear, flower, doll, etc.</li> <li>• Ref to colour/graphics to reflect gender e.g. feminine colours, &amp; popular/relevant images</li> <li>• Add a clear window in the package to show part of the box contents</li> <li>• Use images of the assembled products to show examples</li> <li>• Possible reference to materials e.g. translucent polypropylene sheet, glitter effect finish etc</li> <li>• Credit reference to use of eco-friendly materials, reduced packaging (retail use)</li> </ul>	16	<p>Breakdown:</p> <ul style="list-style-type: none"> <li>• Very simple diagrams. Basic notes/labels with little or no consideration given to age or gender of target market.  (0 – 6 marks)</li> <li>• Better diagrams. Notes give some consideration of target market using product shape, colour, graphics that are relevant  (7-12 marks)</li> <li>• Excellent diagrams &amp; notes taking full account of target market through product shape, description of colours, graphics, etc.  (13- 16 marks)</li> </ul> <p>Max 12 marks if no diagrams.</p>
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