



General Certificate of Education

**AS Design and Technology
Product Design (3-D Design)
1551**

PROD1

Materials, Components and Application

Mark Scheme

2009 examination – June series

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 meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting 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 the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting 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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Quality of Written Communication

The following marks are allocated to the quality of the candidate's written communication. Make a separate assessment of the candidate's overall ability as demonstrated across the paper using the criteria given below.

<i>Performance Criteria</i>	Marks
The candidate will express complex ideas extremely clearly and fluently. Sentences and paragraphs will follow on from one another smoothly and logically. Arguments will be consistently relevant and well structured. There will be few, if any, errors of grammar, punctuation and spelling.	4
The candidate will express moderately complex ideas clearly and reasonably fluently, through well-linked sentences and paragraphs. Arguments will be generally relevant and well structured. There may be occasional errors of grammar, punctuation and spelling.	3
The candidate will express straightforward ideas clearly, if not always fluently. Sentences and paragraphs may not always be well connected. Arguments may sometimes stray from the point or be weakly presented. There may be some errors of grammar, punctuation and spelling, but not such as to suggest a weakness in these areas.	2
The candidate will express simple ideas clearly, but may be imprecise and awkward in dealing with complex or subtle concepts. Arguments may be of doubtful relevance or obscurely presented. Errors in grammar, punctuation and spelling may be noticeable and intrusive, suggesting weaknesses in these areas.	1

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.

(low mark range)
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.
(mid mark range)
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.
(high mark range)
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.

Question	Part	Sub Part	Marking Guidance	Mark	Comments
1	a	i	Thermoset means the material is set with the application of heat. Usually, once set, they can not be reshaped by further application of heat	2	
1	a	ii	Urea Formaldehyde is used in electrical fittings	2	Accept Phenol Formaldehyde Epoxy Resin Polyester Resin Bakelite Melamine
1	a	iii	It is does not conduct electricity. Can be injection / compression moulded Very hard / durable material Fire resistant	1	
1	b		They are difficult to recycle. Alternatives: Limited colours, long curing time slows manufacture, etc	1	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
2	a		Smart materials react to an input such as temperature change. They might change colour or change shape	1	
2	b	i	<p>Thermochromic pigment is used in thermometers.</p> <p>If a smart material is given but product is inappropriate award 1 mark.</p> <p>If the smart material is incorrect but product is described e.g. colour changing kettle = 1 mark</p>	2	Accept Smart grease Smart putty, and Polymorph Memoflex
2	b	ii	<p>It is much safer and easier to use than a mercury thermometer.</p> <p>Etc</p>	1	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
3			Acrylic to acrylic = Tensol (B)	1	Accept Contact Adhesive (C) Accept Epoxy Resin (D)
			Thermoset laminate to chipboard = Contact adhesive (C)	1	Accept Epoxy Resin (D)
			MDF to MDF = PVA (A)	1	Accept Contact Adhesive (C) Accept Epoxy Resin (D)
			Nylon to aluminium = Epoxy resin (D)	1	Accept Contact Adhesive (C)
					Note: Must use each of the options only once. If any letter used more than once only give credit for one of these answers.

Question	Part	Sub Part	Marking Guidance	Mark	Comments
4	a	i	Carton board Accept B-flute card Accept corrugated No marks for cardboard	1	
4	a	ii	Carton board is used because it can be recycled as boxes are a short lifecycle product. Carton board is inexpensive which is important in a mass produced disposable product. Etc Award marks for either two points or one point explained	2	If cardboard given in (i) do not double penalise Give marks for relevant properties in (ii) If no answer in (i) do not give marks for (ii)
4	b	i	Low density polyethylene Alternatives- Acetate Etc	1	Accept polyethylene, PVC, PET, PLA (Polylactide), Ecofilm Not PP, HIPS, ABS
4	b	ii	It is a thermoplastic and so can be recycled. It is transparent so consumers can see inside the package. One explained reason will give 2 marks Two points will give 2 marks	2	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
5	a		<p>Polycarbonate (PC) Polycarbonate has good impact resistance. Safety glasses need to protect the user from flying debris, swarf, etc. Polycarbonate has good optical properties. The material must not obscure vision- especially important when operating machines. Polycarbonate is lightweight-good for the comfort of the user. Etc.</p>	4	1 – 2 marks per relevant point. 2 marks where point is explained or for further detail relevant to product function, manufacturer or aesthetics.
5	b		<p>Silver Silver is a precious metal and therefore has the associated 'status' which is desirable to have with an item of jewellery. It has good aesthetic properties because when polished it shines and looks attractive to consumers. Silver can be soldered, cast, etc to make the various shapes required in such items.</p>	4	1 – 2 marks per relevant point. 2 marks where point is explained or for further detail relevant to product function, manufacturer or aesthetics.
5	c		<p>Holographic card Gives an interesting visual affect as it changes as it is moved in the light. Card can be scored, cut and folded from a net into the box</p>	4	1 – 2 marks per relevant point. 2 marks where point is explained or for further detail relevant to product function, manufacturer or aesthetics.
5	d		<p>Degradable polymers. Degradable polymers dissolve in water, releasing the detergent into the washing. Refill sachets will degrade in landfill Can be printed upon Max 3 marks if no ref to degradable</p> <p>Degradable polymers completely dissolve, leaving no packaging to dispose. Degradable polymers can be 'plastic welded' to seal the sachets.</p>	4	1 – 2 marks per relevant point. 2 marks where point is explained or for further detail relevant to product function, manufacturer or aesthetics.

			Degradable polymers can be made into a thin film, necessary for the manufacture of the sachets.		
5	e		<p>Flexi-ply Flexi-ply can be bent over a former easily in order to make the shape of the furniture Flexi-ply can be laminated with other sheets of flexi-ply to form shape. Can be painted, stained, etc. Can be veneered Etc</p>	4	<p>1 – 2 marks per relevant point. 2 marks where point is explained or for further detail relevant to product function, manufacturer or aesthetics.</p>

Question	Part	Sub Part	Marking Guidance	Mark	Comments
6	a		<p>A white coloured high quality card is required to ensure that the printed colours and graphics appear bright.</p> <p>Packaging is an important factor in the retail of such products. It is more desirable to touch and to look at if its made from a good quality card.</p> <p>A higher quality card will be more rigid and will score and fold more precisely without the surface layer breaking.</p> <p>Gives more resistance to damage</p> <p>The surface is much smoother than lower grade cards, making it ideal for printing graphics. Etc</p>	4	1 – 2 marks per point. 2 marks where point is explained or for additional detail relevant to product function, manufacture or aesthetics.
6	b	i	High Impact Polystyrene (HIPS), PVC, PET only	1	
6	b	ii	<p>HIPS is available in transparent form which makes it easy to see the product inside.</p> <p>HIPS can be vacuum formed or thermoformed to make the shape required.</p> <p>HIPS can be recycled which is important in a disposable, short lifecycle product like this. Etc.</p> <p>DON'T DOUBLE PENALISE IF (i) IS INCORRECT</p>	6	1 – 2 marks per point. 2 marks where point is explained or for additional detail relevant to product function, manufacture or aesthetics
6	b	iii	<p><u>Accept either vacuum forming, dome forming or thermoforming only</u></p> <p>Breakdown</p> <ul style="list-style-type: none"> Basic diagram of a suitable manufacturing process with a few points labelled 	9 0 - 3	1 mark for stating correct process

			<p>E.g. simple diagram of vacuum former with some point labelled but likely to be unclear.</p> <ul style="list-style-type: none"> • Better diagram of a suitable manufacturing process with all points labelled and some explanatory notes. <p>E.g. diagram of vacuum former with details such as mould, heater, plastic sheet labelled and notes a basic but correct.</p> <ul style="list-style-type: none"> • Detailed diagram with all points labelled and a good explanation of the process <p>E.g. detailed diagram of vacuum former with details such as heater, plattern and mould added. Notes are correct with a good, step by step description of the process</p> <p>Max 5 marks if no diagram</p>	<p>4 – 6</p> <p>7 - 9</p>	
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Question	Part	Sub Part	Marking Guidance	Mark	Comments
7	a	i	Jelutong, MDF, Styrofoam, Model board (Obamodulin), Starch based / ABS RPT material Allow Vac formable Polymers e.g. PP, HIPS, ACRYLIC, ABS, Accept Polyester resin (P.R), Casting resin Clay Allow Aluminium	1	NOTE: Look at (ii) if production version award ZERO mark for (i)
7	a	ii	- Jelutong is easy to shape with hand tools because it is a soft material - Jelutong sands well with glass paper to achieve a smooth finish, necessary for painting - Jelutong machines well, without splintering and splitting. This is necessary to obtain a good finish and detail - Etc	4	1 - 2 marks per point. 2 marks where point is explained or for additional detail relevant to product function, manufacture or aesthetics. NOTE: IF A PRODUCTION VERSION IS BEING DESCRIBED NO MARKS
7	a	iii	Expect notes and diagrams of modelling processes. Styrofoam - shaping with hot wire cutter, glass paper, etc Jelutong/MDF - shaping with hand tools e.g. coping saw, glass paper, drills, etc (NO MARKS FOR 'CAD/CAM') - CNC router/milling - Resin casting - Vacuum forming - Sand casting - Rapid Prototyping IF no diagrams included award max 4 marks	8 0 – 3 4 – 5 6 – 8	IF PRODUCTION VERSION: accept injection moulding, die casting or press forming Basic diagram of a suitable manufacturing process with a few points labelled 1 mark for stating correct process Better diagram of a suitable manufacturing process with all points labelled and some explanatory notes. Detailed diagram with all points labelled and a good explanation

7	a	iv	<p>Acrylic spray paints. Jelutong is sanded and cleaned. Acrylic primer is sprayed on using aerosols. This is done in light coats and allowed to dry. High points are sanded, and residue cleaned off. Top coats are applied using aerosols. Drying time in between coats Finish with lacquer to create a hard, shiny finish.</p> <p>IF PRODUCTION VERSION: - Accept powder coating - Accept anodising - Accept plastic dip coating - Accept details such as filing off rough edges of polymer - Give credit for reasons why an applied finish is not needed</p>	6	<p>No marks for 'paint'</p> <p>0 – 2 Non specific finish named. Basic description of process</p> <p>1 e.g. "Sand model down. Apply paint with a brush"</p> <p>2 "Sand model down with abrasive. Apply paint using a paint spray"</p> <p>3 – 4 Specific finished named. Reasonable description of process using some correct terminology. Some stages maybe missing.</p> <p>e.g. Sand model down with different grades of glass paper, starting with rough and then finishing with smooth. Clean off and apply a primer using aerosol. When dry, apply top coats.</p> <p>5 – 6 Specific finished named. Detailed description of process using correct terminology. Most of the stages included.</p>
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7	a	v	<p>A dust mask may be worn to prevent inhalation of dust which can irritate the lungs An extractor may be used to remove dust when sanding or fumes from paint. Spray paints should be kept away from sources of ignition. COSHH guidelines need to be followed when storing/handling finishing materials Etc</p> <p>Accept ref to H & S signage</p>	<p>4</p> <p>1</p> <p>2</p>	<p>1 - 2 marks per health and safety measure. 2 marks where precaution is linked to hazard, for further detail or explanation.</p> <p>e.g. "wear a dust mask"</p> <p>"wear a dust mask to prevent inhalation of MDF dust which can irritate the lungs"</p> <p>Maximum 2 marks for simple list of personal protective clothing.</p> <p>Or simple list of points</p> <p>e.g. Wear a dust mask, goggles, and overalls, etc</p>
7	b	i	<p>Aluminium has good aesthetic qualities and doesn't corrode. No further finishing is needed. Aluminium can be machined relatively easily with machines such as lathes, etc.</p>	4	<p>1 - 2 marks per point. 2 marks where point is explained or for additional detail relevant to product function, manufacture or aesthetics.</p>
7	b	ii	<p>Machining on a CNC lathe gives an excellent finish Repetitive jobs, identical bottoms are easy to make on a CNC lathe</p>	4	

7	c		<p>Answers might include:</p> <ul style="list-style-type: none"> - Provision of a screen to display track/volume/battery information. - Improve appearance by reducing the overall size. - Make it more slimline so it fits in your pocket/hand easily. - Use TPE or LSR overmoulding to vary texture for grip and improve aesthetic appeal. - Change in colour to more commonly accepted silver & black. - Looks smooth and attractive to pick up 	9	<p>Award up to 4 marks for sketches</p> <p>Then 1 mark per point and second mark where point is explained.</p> <p>MAX 7 if no diagrams</p>
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