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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

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

PROD1

Materials, Components and Application

Mark Scheme

2009 examination – January 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.

Performance Criteria	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	Low Density Polyethylene (LDPE). Accept polythene or PE	1	
1	a	ii	They can be recycled. Thermoplastics can be calendared to make a thin film	2 x 1	One mark each Accept they can be easily moulded or formed into a film.
1	b	i	To help it biodegrade	1	Accept reference to benefits to environment
1	b	ii	They might contaminate plastics that are to be recycled if a biodegradable polymer is mixed in with them. They might degrade prematurely e.g. if exposed to UV or moisture, etc	2 x 1	One mark each Accept they cannot be recycled or re-used for any length of time. Accept they still take a long time to degrade. Does not tackle resource depletion. Does not encourage recycling. Sometimes do not fully degrade.

Question	Part	Sub Part	Marking Guidance	Mark	Comments
2	a	i	Accept any of the following MDF, plywood, chipboard, blockboard, hexaboard, hardboard, gluelam, etc	1	Accept veneered timbers or timbers with a laminate.
2	a	ii	They are generally available in longer, wider boards. Some are cheaper than natural timber. They tend to be stable, defect free, etc They combine properties of materials giving a superior material e.g. increased strength. Accept 'they are stronger'. Improved aesthetics e.g. veneer or laminate. Can be easier to machine, easier to work with. <u>Do NOT accept they are cheaper to manufacture.</u>	2 x 1	One mark per advantage Accept 'they are cheaper'. Less prone to decay.
2	b	i	Accept any of the following: - Carbon fibre reinforced plastics (CFRP) - Glass reinforced plastic (GRP)	1	Accept fibre glass Accept carbon fibre.
2	b	ii	Composites like CFRP are lighter than metals, giving the car greater performance. Accept simply 'lightweight' Accept goods strength to weight ratio CFRP can be moulded into a variety of shapes, adjusted relatively easily by making simple modifications to moulds, etc Weather resistance properties of polymer based composites. 'Self finished' and paints can be applied.	2 x 1	One mark for each reason

Question	Part	Sub Part	Marking Guidance	Mark	Comments
3	a		Mild steel is a ferrous metal. It contains iron therefore it is classed as ferrous. Aluminium is a non ferrous metal. It does not contain iron, etc	2	
3	b		Tube, bar, sheet, angle, channel/profile, plate, ingot/'castable'	2 x 1	1 mark if only 1 correct form given.
3	c	i	An alloy is a mixture of two or more metals. Etc	1	
3	c	ii	Stainless steel is an alloy. It is used in products like kitchen utensils. Pewter and jewellery. Aluminium and car wheels. Stainless steel - boat fittings.	2	
3	c	iii	It doesn't corrode, etc Aluminium is light but strong. It keeps the vehicle weight down. Stainless steel does not react to saltwater. Pewter is a cheaper alternative to silver.	1	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
4	a		HDPE is a tough material which will take impacts from tools being dropped, etc HDPE can be moulded into ergonomic shapes to fit in the hand, etc Weather resistance. Cheap material needed for high volume (mass) production. Hard wearing material.	4	Accept durability. Accept can be coloured for improved aesthetics, or recognition of tools. Accept it is lightweight. Accept electrical insulator.
4	b		FSC timber is grown in sustainable forests, this is needed as a plentiful supply is required by the furniture industry. FSC timber is sourced from UK and European countries and is therefore more widely available, bring the cost of the material down, etc	4	Accept 'environmentally friendly'. <u>Do not accept simple/ obvious generic qualities of timber</u> e.g. ability to be machined, joined, varnished etc
4	c		Multi sheet card provides the stiffness/rigidity to make a suitable carton. It allows for a top sheet of white card which enhances appearance of graphics, etc	4	Accept reference to biodegradable, ease of construction into 3D shape. 'Easy' to print on.
4	d		It can be scored and bent to make the necessary folds for it to stand up It can be easily joined with snap fittings, allowing it to be flat-pack, etc Lightweight – good for transport. Can be flat-packed. Acts as an insulator keeping food warm.	4	Variety of colours for improved aesthetics. It can be printed on. Weather resistance for external displays.
4	e		SMAs react to heat. Bone fixings will tighten in response to body temperature. This keeps the bone together. Standard titanium fixings loosen.	4	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
5	a		Stainless steel, aluminium alloy, etc	1	
5	b		Stainless steel has good aesthetic properties - looks appropriate for a modern kitchen interior. Stainless steel is a malleable material so it can be press formed into the required shape. Stainless steel does not corrode. Therefore it maintains a good, clean/hygienic finish, etc	6	 Accept 'easily shaped' Accept high melting point. Not affected by heat.
5	c		Accept piercing and blanking of stock sheet Press forming operations. Breakdown • Basic diagram of a suitable manufacturing process with a few points labeled E.g. simple diagram of punch and die with little detail. Labels such as 'mould', 'plunger'. Major points missing. • Better diagram of a suitable manufacturing process with all points labelled and some explanatory notes. E.g. die resembles product, some specific parts correctly labelled such as press, clamps, etc. Step by step process in note form but may have some steps missing or lacks clarity • Detailed diagram with all points labelled and a good explanation of the process	9 0 – 3 4 – 6 7 - 9	Accept laser/ water jet cutting. Accept term 'compression moulding' where press forming is meant. 1 mark for stating correct process Credit finishing such as 'brushing'.

			E.g. die clearly resembles the product. Details of clamp, dies, press, possibly labeled up product as 'blank', piercing, and then pressing. Step by step process is correct with few if any details missing for the top mark.		
5	d		Resists heat from the toaster. Thermoplastics might deform leading to malfunction of the controls. Insulates user from heat. Stainless steel body would get hot so the control needs to be kept cool, etc Accept hardness/ strength/ durability required for frequent use. Credit reference to cross linked polymer chains.	4	1 mark per point. Second mark where point is explained.

Question	Part	Sub Part	Marking Guidance	Mark	Comments
6	a	i	Accept- LDPE,HDPE,PP	1	Accept acrylic, PE or polyethylene
6	a	ii	HDPE is a thermoplastic so it can be injection moulded. This is how the product would be made. HDPE can be coloured with pigments in the polymer. This makes it safe as applied finishes would wear off, etc	4	Accept ref to strength, flexibility, 'can be moulded', lightweight, making it easy to hold etc.
6	a	iii	Correct answer is TPE However, accept any suitable thermoplastic as most can be made into a TPE form. Do not accept rubber.	1	Accept silicone, HDPE, HIPS, Acrylic, PET, ABS
6	a	iv	TPE is a thermoplastic so it can be injection moulded/overmoulded. TPE can be coloured, giving it attractive aesthetics which appeal to children. Impact resistance, grip properties, can be coloured, water resistance	4	Candidates could give same properties as (a) (ii)
6	a	v	• Basic diagram of a suitable manufacturing process with a few points labelled E.g. simple diagram of injection moulder. Generic mould with little detail. Labels such as 'screw', 'plunger'. Major points missing. • Better diagram of a suitable manufacturing process with all points labelled and some explanatory notes. E.g. Mould resembles product, some specific parts correctly labelled such as Archimedean screw, hydraulic system,	6 0 – 2 3 – 4	1 mark for stating correct process

			etc. Step by step process in note form but may have some steps missing or lacks clarity • Detailed diagram with all points labelled and a good explanation of the process E.g. Mould clearly resembles the product. Details of spit lines, water cooling, possibly cores, etc. Specific correct terminology such as 'ejector pins, 'hydraulic ram'. Step by step process is correct with few if any details missing for the top mark.	5 - 6	
6	b		- No small or loose parts that may form a choking hazard. - All parts moulded together rather than using adhesive. - No toxic materials or finishes are used which might otherwise harm the user. - All parts are rounded. Filaments are soft and rounded so as not to damage gums. - Appropriate parental safety guidance given on packaging, etc - Health and safety or QA checks by manufacturer.	4	Award 1 mark per point and second mark for explanation.
6	c		Answers may include: - Smaller head size suitable for children's mouths - TPE gives the toothbrush improved grip- good when hand are wet - Details such as the wheels, etc give it a chunky grip, making it easier to grip but perhaps less comfortable. - Smaller handle and neck suitable for children's hand and mouths. Breakdown • Basic diagrams with little	12	

			analysis. Mostly descriptive points. • Better diagrams, some comments outlining strengths or weaknesses and simple suggestions for improvements • Good quality diagrams, most of the ergonomic/.anthropometric features analysed and appropriate suggestions for improvements	0 – 3 4 – 8 9 – 12	
6	d		- Thermochromic pigments could be used in the handle. As the child holds the handle, it will change colour. This could be used to indicate when the child has used the brush for long enough or simply used to encourage children to clean teeth. - Polymorph could be used on the handle to allow user to mould the handle to fit their hand. - Shape memory alloy could be used as this could make the handle change shape when used making it more fun to clean teeth. - Grips could 'appear' on handle as it heats. - SMA's could allow the neck to be more flexible but return to shape after use. - Thermochromic pigments could be used in the bristles (as above). Phosphorescent pigments might be used to highlight a design on the handle which would glow in the dark. A feature that would appeal to children and make brushing teeth more fun.	8	Award 1 mark per point. Award second mark for explanation. Award up to 3 marks for suitable diagrams. Award 1 mark for naming an appropriate Smart material.