General Certificate of Education

Design and Technology: Product Design 3D

PROD1

Mark scheme

2550

June 2013

Version/Stage: 1.0

Mark schemes are prepared by the Lead Assessment Writer 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 associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

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Section A

Answer all questions in Section A

Question 1

Question	Part	Sub Part	Marking Guidance	Mark	Comments
1	a		Biodegradable/compostable	1	
1	b	i	E.g. food packaging Detergent sachets Surgical stitches Plastic bottles Plastic bags Cutlery etc Accept references to 3D printing.	1	
1	b	ii	E.g. Food packaging has a short lifecycle. It may go to landfill and therefore to protect the environment, such polymers need to biodegrade. E.g. PLA can be made into films to make plastic bags to contain food or Biopol can be blow moulded to make bottles to contain food products. **Breakdown:** 1 mark for relevant property. 1 mark for explanation Credit reference to the negative aspects of biodegradable polymers e.g. they don't fully degrade, they create greenhouse gases when degrading, they encourage waste instead of re-use. 2x2 marks	4	If no application in 1bi award zero in 1bii

Question 2

Question	Part	Sub Part	Marking Guidance	Mark	Comments
2	a		Smart materials	1	
2	b	i	E.g. Shape memory alloy- surgical bone fixings, dental braces, spectacle frames, 'muscle wires' for use in robotics/bionics, heat activated switching, stents, springs/screws in electronic equipment such as mobile phones etc. Or thermochromic sheet- thermometer, baby bath temperature indicator, kettle, etc	1	

2	b	ii	E.g. thermochromic sheet will change colour in response to heat so it can indicate if body/water temperature is too hot or too cold. E.g. shape memory alloy is non-toxic and will not contaminate the patient. Shape memory alloy screws will expand/contract when heated by body heat- therefore screws will tighten and bone fixings will fit securely. **Breakdown:** 1 mark for **each** relevant property 1 mark for **each** explanation 2x2 marks	4	If no application in 2(b)(i) award zero marks in 2(b)(ii) If application is incorrect/ inappropriate award zero.

Question 3

Question	Part	Sub Part	Marking Guidance		Mark	Comments
3	a				4	
			Non Ferrous	**Ferrous**		
			Aluminium	Stainless steel		
			Titanium			
			Brass			
3	b		E.g. Brass- Door furniture, window locks, padlocks, taps, plumbing fittings, electrical plug pins, etc Titanium- jewellery, watches, bone fixings, hip replacements, etc. Aluminium- Drinks can, alloy wheels, cycle frame, engine components, etc. Stainless steel- kitchen sink, saucepans, kitchen utensils, cutlery, etc. **If no metal given- 0 marks**		1	

Question 4

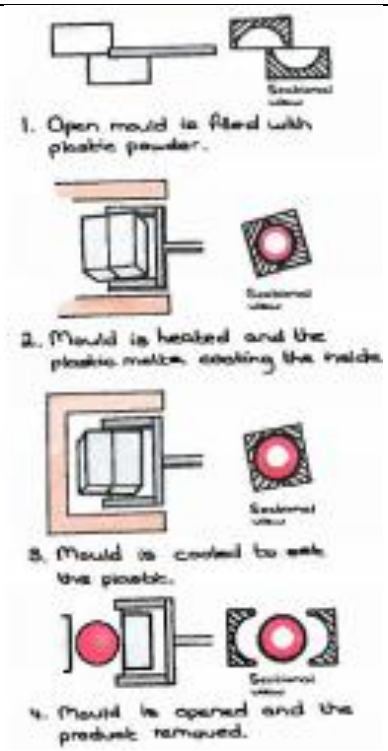
Question	Part	Sub Part	Marking Guidance	Mark	Comments
4	a		Hazardous to the environment materials such as: • Adhesives (accept glues) • Solvents e.g. thinners • Paints • Polishes • Stains • Oils or lubricants • Cleaning products e.g. bleach, turps, • Resin e.g thermosetting resin • Lead • Mercury • (accept specific branded substances)	1	
4	b		E.g. Ensure that the product is stored in the original container with correct labelling. Ensure that the product is disposed of correctly (according to manufacturer's instructions) when it is finished with. Dispose of at authorised recycling centres Accept references to relevant PPE precautions e.g. wear protective gloves and goggles. **Breakdown:** Ref to safe storage or safe disposal award 2 marks	2	If no substance named in 4(a) award zero in 4(b)

Section B

Answer one question in Section B (Question 5 or 6)

Question 5

Question	Part	Sub Part	Marking Guidance	Mark	Comments
5	a		E.g. PP is a thermoplastic which is the type of polymer needed for rotationally moulding PP has good impact resistance so it will withstand the wear and tear of being used, minor impacts from being knocked by other furniture, etc. PP is totally waterproof and chemical resistant so it won't be affected by cleaning, etc. PP is food safe, therefore it is safe for small children to place food on the table and then eat it. Like all polymers, PP can have a pigment added to enhance the aesthetics. PP is a rigid polymer. Self-finishing – 1 mark Can be coloured – 0 marks Must make reference to dyes/pigments Can be easily cleaned – 0 marks **Breakdown:** 1-2 marks per reason. Award second mark for explanation. Max **three** marks for a simple list of properties without explanation.	6	

5	b		 E.g. Description • Mould halves are opened and the required quantity of polymer & pigment is added. • Moulds are closed and rotated • The rotating moulds move into a heating chamber which causes the polymer to melt • As the moulds rotate, the thickness of the melted polymer builds up on the inside of the mould. • The moulds are moved to a cooling chamber to harden the polymer. • The moulds are opened and the product removed. • Any excess polymer/flash would be removed. **Breakdown:** Very simple description. Diagrams maybe unclear. There may be several omissions.(0-3 marks) Better description. Diagrams are of better quality. Only minor omissions (4-6 marks) Full answer. Clear diagrams. All points included. Mould must be in the shape of the product (7-10 marks) **If no diagrams, award max 5 marks**.	10	

5	c		E.g. Rotational moulding creates a hollow product with an even wall thickness, several millimetres thick. Every product will be identical which is important for quality standards required in such items. Rotational moulding is suitable for large batch production. Such chairs would be made for thousands of restaurants. It would not be economical to injection mould which would require complex cores to make a hollow product and plastic welding to assemble. Does not produce any waste as there is an exact amount of powder used. Credit reference to inexpensive initial set-up costs. **Breakdown:** 1-2 marks per point depending on clarity/relevance and detail. 2x2 marks	4	

Question 6

Question	Part	Sub Part	Marking Guidance	Mark	Comments
6	a	i	**Pine- interior furniture** Pine is a sustainable timber- grown in managed forests ensuring long term supply required for furniture production. Pine is not the best material for exterior joinery because it will rot unless treated with preservatives. It is best used for interior purposes. Pine is relatively soft, making it easy to work with hand tools and will not blunt planers, saws etc like some hardwoods will. Pine is widely available and therefore suitable for manufacture at any scale of production. Pine has an attractive colour and grain to suit modern interiors Pine can be finished with a variety of stains, varnishes or paints to suit a wide variety of tastes/fashions. Cheaper than hardwood such as oak. **Breakdown:** 1-2 marks per reason. Award second mark for explanation. Max **four** marks for a simple list of properties without explanation.	8	

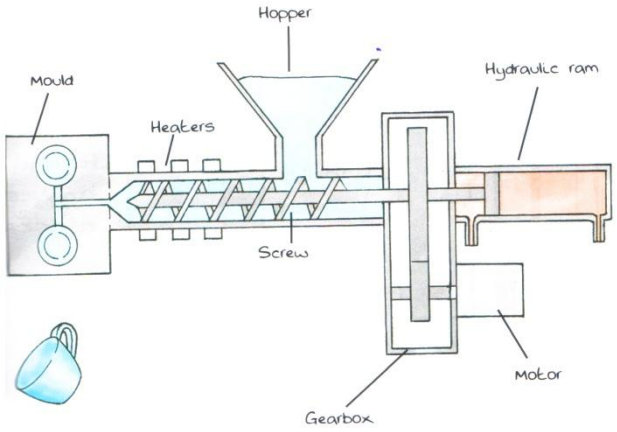
6	a	ii	**Metal effects card- Gift boxes** Like all card, it is available in long, wide boards- essential for mass production. Like all card, metal effects card is a compliant material. It can be die cut and scored which is required in the manufacturing process to make 3D box shapes. The metal effect gives the card an attractive aesthetic quality which makes the card more suitable for a gift box rather than plain card. Metal effects card can be embossed with a logo which might be important for branding purposes. Metal effects card would be more rigid than standard, multi-sheet card. This gives the box more durability and a 'feel' of quality. Some recycling facilities are able to separate the laminations which would make the card recyclable. This is important in a product such as a gift box that would have a short lifecycle. Can be laser cut, die cut or a forme can be made. Credit reference to printing on the white side only. **Breakdown:** 1-2 marks per reason. Award second mark for explanation. Max **four** marks for a simple list of properties without explanation.	8	
6	b		E.g. Laminated card might be suitable which would give a glossy finish to the card to make it aesthetically pleasing. Or multi-sheet card which can be printed on using offset lithography Or holographic card which has a surface that changes with movement in the light, making it aesthetically pleasing. Or carton board Or corrugated card. Accept references to lightweight for posting etc **Breakdown:** 2 marks for a specific compliant material 1-2 marks for relevant reason. (2 marks for detailed explanation)	4	

Section C

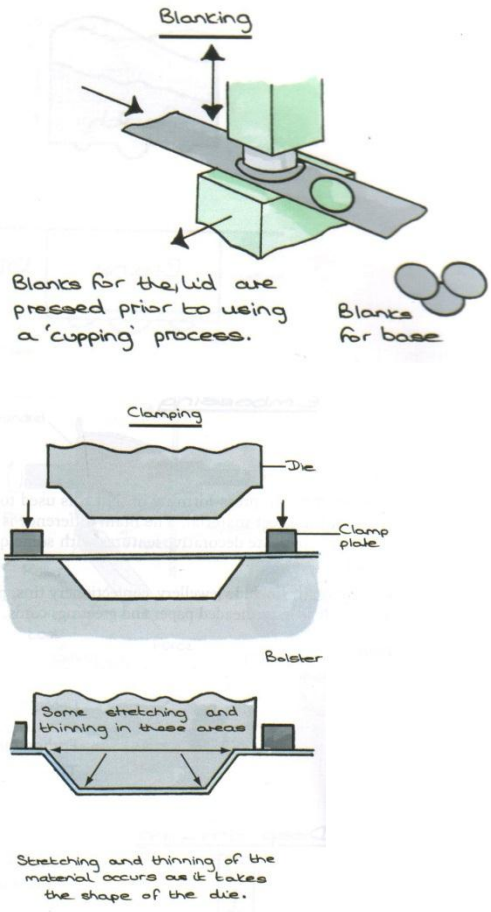
Answer question 7 in Section C

Question 7

Question	Part	Sub Part	Marking Guidance	Mark	Comments
7	a	i	Accept any of the following: Acetyl or Polyoxymethylene (POM), Polycarbonate (PC), ABS. Also accept High Density Polyethylene (HDPE), Polypropylene (PP), HIPS, etc. Do not accept: Acrylic, UF, MF, Polystyrene, PVC, LDPE. If a list of polymers is given and one is incorrect – 0 marks	1	
7	a	ii	Acetyl has high abrasion resistance which makes it ideal to resist wear on the moving parts. Acetyl has a high co-efficient of friction so the moving parts won't wear away. Acetyl, like all polymers can have a pigments added to provide the attractive colours for the product. **Breakdown:** 1-2 marks per reason. Award second mark for explanation. Max **three** marks for a simple list of properties without explanation.	6	

7	a	iii	 Stage 1- Polymer granules and pigment are added to the hopper Stage 2- The polymer is moved forward by the Archimedean screw to heaters which melt the polymer. Stage 3- When a sufficient charge of polymer has melted, it pushes the Archimedean screw back. A hydraulic ram moves the Archimedean screw forward which injects the polymer into the mould. Stage 4- When the polymer has set in the watercooled mould, the mould halves open. The product is then removed by ejector pins. Stage 5- The sprue or excess polymer is removed. **Breakdown:** • Very simple description. Diagrams may be unclear with incorrect labels or incomplete parts. (0-3) • Better description using correct terminology. Diagram mostly complete and correct. (4-5) • Full description using correct terminology for all stages. (6-8) **No diagram but full description = max 4 marks**	8	
7	b	i	Stainless steel, aluminium, aluminium alloy, duralumin.	1	

7	b	ii	E.g. Stainless steel does not corrode when exposed to moisture and air. Corrosion would make the sink look unsightly. Stainless steel is malleable/ductile so it can be press formed into the shape of the sink. Stainless steel has an attractive silver appearance which makes it aesthetically pleasing and suitable for a modern setting. Stainless steel is hard, which means it will resist scratching and indentation. Stainless steel is chemical resistant which means it can be cleaned with bleach, etc. **Breakdown:** 1-2 marks per reason. Award second mark for explanation. Max **three** marks for a simple list of properties without explanation. If application is incorrect/inappropriate award zero marks.	6	No metal named in 7(b)(i) award zero. If material named is incorrect, award marks for relevant properties. Do not double penalise.

7	b	iii	 Stainless steel sheet would be unrolled (from stock roll) and straightened. The sheet would be punched into blanks. The blanks are transferred to a press where they are clamped. The press pushes the sheet into shape. There may be several pressings to achieve the shape and additional punching to remove the holes for the plug, taps and overflow. Credit reference to cupping to create bowl shape. Accept reference to spinning the bowl shape. Ignore references to tap manufacture. Candidates can answer with reference to the base and/or the bowl section. Award marks for detailed description. E.g. if candidate	8	

			gives a fully detailed descriptor of the square base section only, they can achieve max 8 marks. **Breakdown:** Very simple description. Diagrams maybe unclear. There may be several omissions. (0-3 marks) Better description. Diagrams are of better quality. Only minor omissions (4-5 marks) Full answer. Clear diagrams. All points included. (6-8 marks)		
7	c		Expect reference to the following: • Possible inclusion of infra-red sensors for hands-free use of the soap dispenser and sink taps. • Possible inclusion of lever action taps to make it easier than push button. • Possible use of TPE grip on the taps/soap dispenser • Use of a graphic to show how the taps are operated • Use of further graphics and text to encourage use. • Possible interactive feature such as LEDs/Voice recording that encourages use. • Alternative design to sink e.g. 'Pod' with automatic soap, water and dryer **Breakdown:** Very simple solution. Diagrams maybe unclear. Basic drawings, limited detail. (0-4 marks) Better solution. Good annotation. Diagrams are of better quality. (5-7 marks) Full answer. Feasible solution with full annotation. Clear diagrams. (8-10 marks) **If answer only addresses one of the bullet points in the question- max 5 marks.**	10	