GCE

Design and Technology: Product Design 3D

PROD3 – Unit 3

Mark scheme

2551

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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.

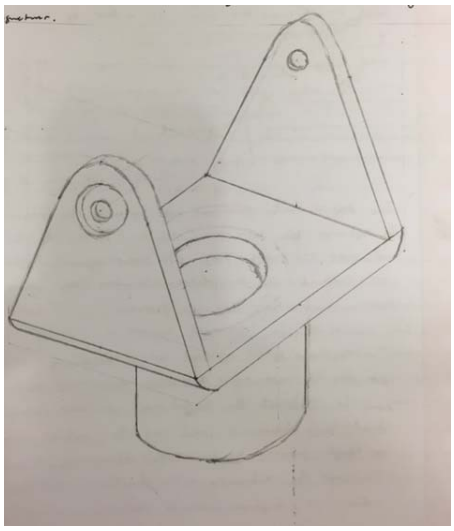
It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment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

Further copies of this mark scheme are available from aqa.org.uk

Question	Part	Sub Part	Marking guidance	Mark	Comments

1	01		Mark Bands 0 Marks No answer worthy of credit 1-2 Marks The response gives a simple description of the view/model and why it may be used. 3-4 Marks The response gives reasons for the use of the view/model and who it would be most suitable for in the design process. 5 Marks The response gives specific reasons for the use of the view/model and relates them to a specific situation where it would be used. **Indicative content:** **Sectional views** • allows a person to see hidden components within a product. • Understanding of how parts fit together in places not seen from the outside. • They are a form of communication used by a manufacturer/engineer. • Moving parts can be simulated using CAD to show the extent of movement within hidden regions. **3D CAD Renderings** • Generated at the end of the design process, or possibly when selecting a final concept. • Used in focus group situations to show the final 3D form. • Can also be used to generate marketing materials prior to final production. • The use of renderings allows products to be shown in their real environment prior to production. **Exploded views** • They enable the viewer to see all	4x5	**Reward references to specific users and relevant uses of the view/model** **Responses with diagrams may be seen for sectional views and/or exploded views. Do not penalise if not present.** **Do not give marks for general CAD references, points need to be specific to the view described.**

			components within a product and how they align when being assembled. • The production of assembly instructions with exploded drawings means that the products can be more easily interpreted by people from all countries without the need for translation. **1/10th scale model** • Scale models are used in many situations, one example of which would be the production of a final concept model for a racing yacht, the production of a full sized model would be impossible due to the cost. • By producing a small scale version the designer can test the product in simulated environmental conditions prior to investment in the real thing. **This is not an exhaustive list, other relevant points made should be rewarded.**		

1	02		Mark Bands 0 Marks The sketch is not recognisable as the object, or is drawn in 2D only 1-2 Marks The sketch is recognisable as the object 3-4 Marks The sketch shows most of key features, but issues may be seen in the shape or positioning of some. Issues with proportion/distortion may be present. 5-6 Marks The sketch is clear with all key features shown. Some minor issues with feature positioning may be seen. 7-8 Marks The sketch shows all key features correctly positioned/represented. The proportion is largely accurate and line work is clear.  *Image showing an 8 mark response with all key features.* **Key features:** • A cylindrical base (not square) • Counterbored holes. • Filleted edges on the main base. • Vertical through hole in the base • Material thickness	8	

2	03		Marks should be awarded as follows: 1 mark for naming a suitable specific material: *Accept either GRP,GFRP, CFRP, Carbon Fibre Reinforced Polymer, Glass Reinforced Polymer* 1 mark for referring to each constituent part of the composite: *Glass fibre sheet, polyester resin/epoxy resin* **Forming stages worth 1 mark each:** • forming of the mould • The application of release agent to the mould would prevent the composite adhering to the mould • The application of a gel coat with pigment would give a smooth surface to the final product. • The application of layers of fibre and resin alternately. • The use of a rolling process between each layer to remove bubbles. • leaving the component to cure • removing the component from the mould • removal of excess material **Reinforcement worth 1 mark each:** • The application of extra layers of fibre in areas requiring reinforcement • The overlapping of fibre sheets during layering process • The inclusion of folded edges to increase rigidity in the chair form. **Achieving the gloss finish: 1 mark each** • The seat side of the product is in contact with the mould giving a high quality finish • The reverse side of the chair is roughly finished due to layering process. **Other points to watch for:** • draft angles included for ease of removal • male/female mould decision **This is not an exhaustive list, other relevant points made should be rewarded.**	16	**Glass fibre should only be credited as a constituent part if the answer refers to the stock form e.g. sheet** **Do not accept resin as a constituent part of the composite (refer to guidance column)** **Some responses may take the form of annotated diagrams, these should be rewarded.**

2	04		Mark Bands 0 marks: No answer worthy of credit 1-4 marks: The candidate refers to a general product category such as 'the car' or 'mobile phones' and makes minimal reference to any of the suggested points. The points made are generic and lack detail. No clear diagrams included *e.g. 'car engine size has decreased over time to make it more environmentally friendly'.* 5-8 marks The candidate must refer to a specific product and/or movement in the response or make more specific or explained points referring to the points suggested in the question. Diagrams may be included but do not always add to the answer *e.g. 'The mini was developed in the 1950s in response to the Suez crisis, which increased oil prices.'* 9-12 marks The candidate refers to more than one specific product/movement. The points made are well organised and are justified/explained. Where diagrams are used they are relevant and add detail/explanation to the answer *e.g. 'Bauhaus were largely influenced by WW1, where the development of mass production techniques developed rapidly …'* **This is not an exhaustive list, other relevant examples should be rewarded.**	12	**Accept reference to post-modern design for aesthetics as a response to increasing affluence in some areas of modern society (1980s Memphis and Alessi products).**

3	05		**1 mark:** for an accurate definition of the property being tested. **3 marks max:** for diagrams/description of how the test is set up **2 marks max:** for how the test has been made fair. **1 mark:** for how the results will be measured with accuracy (e.g. using callipers, micrometer etc.) **1 mark:** for reference to what will be compared and what indicated a tougher/harder material.	2x8	**Simple workshop tests have been asked for however answers referring to specific tests, such as IZOD or Brinell will be accepted.** **If no diagrams are included then the max mark is 6 for each test.** **A diagram showing how the test is set up is essential, annotations must cover the points stated in the question to access the full mark range.**

3	06		Candidates may refer to some of the following aspects: **Indicative content:** • The ability to adjust mass properties such as density and viscosity can allow for testing of material requirements. • The use of Mould Flow Analysis to check that a mould design will fill with material correctly. • The use of Finite Element Analysis to assess stresses on individual components. • The use of electronic circuit simulation through 'Crocodile Clips' etc. to check prior to production of a PCB. • The use of Virtual Wind tunnels to check products in environmental conditions prior to production and investment in manufacturing facilities. • using dynamic constraints to allow animations of moving components and check for collisions etc. • Using aesthetic testing of models to show in specific environments and material combinations. **This is not an exhaustive list other relevant points made should be credited.**	12	**If a specific test is mentioned award a single mark.** **If the test is explained award a second mark** **If a specific situation/product context is given for the test, award a third mark.**

4	07		**Galvanising:** N.B the fence shown would be hot dip galvanised due to the size **Process:** • Steel is cleaned in caustic solution (removes grease, dirt and paint) • Rinsing of the component • Pickled in acid to remove scale • Rinsing of the component • Flux applied and dried on surface • Steel dipped in molten Zinc • Steel is removed and quenched after reaching temperature of molten zinc bath. **Suitability:** • Ideal for school fencing due to durability and toughness, • Not designed for aesthetics but as a functional deterrent for possible intruders. • The Zinc coating increases life expectancy and is hard-wearing. • Low maintenance finish. **Pressure Treating** N.B reference to tanalising as a specific pressure treatment should be rewarded. **Process:** • Moisture content is reduced through seasoning once cut down. • Timber is placed in a closed vessel • A vacuum and pressure is applied to the timber in the vessel • The chemical is absorbed into the timber in the vessel. • The process can be aided by increased temperature within the vessel Suitability: • The wooden grain is visible and keeps its natural aesthetic • The nature of the finish increases the length of life of the soft wood timber, • The use of a pressure treating process means the chemical penetrates the	2x8	**Rinsing can be credited once only within the process marks.** **The use of a bullet pointed list within the response will cap the mark to 4 per product.**

			timber giving greater protection than a surface finish such as varnish. • Varnish etc. can still be applied as a secondary protection over the pressure treatment. • The green colour associated with the process fades over time blending in with the environment. **This is not an exhaustive list, other relevant points made should be rewarded.**		

4	08		Mark bands: 0 marks No answer worthy of credit 1-3 marks The response makes very few general points with little explanation. 4-6 marks The response makes general points with explanation referring to aesthetics and ergonomics. 7-9 marks Evaluative comments are made with most explained. The response covers both aesthetics and ergonomics. Clear diagrams may be used. 10-12 marks All evaluative comments are explained, relevant diagrams are included to back up the points made. **Indicative content:** • LSR/TPE/TPR over moulding gives an elastic property to the areas of the handle to be gripped. • Over moulding and main body can be changed using pigments to suit different target markets • Anthropometric hand size/grip diameter data has been used in the design of the toothbrush handle. • The handle is shaped ergonomically to increase grip. • LSR under the bristles will help protect gums on impact during brushing. • Bobble texture on the end of the handle increase grip further. • The white gloss finish gives a hygienic appearance needed with a toothbrush. **This is not an exhaustive list, other relevant points made should be rewarded.**	12	**References to rubber as a general material should not be rewarded as this is seen as too generic.** **Accept reference to LSR, TPE and TPR for over moulding material.**

5	09		Award 1 mark for individual process stages Award 1 mark for a process suitability point MIG Welding process: • Component surface is cleaned and prepared. • The component is clamped in position, possibly using a welding jig for repeatability. • The component is earthed • PPE is worn by the operator • The welder is set with appropriate feed rates and current settings • The gas torch is switched on creating an arc with the component. • The weld puddle is dragged/pushed to fuse the joint • The component is left to cool • The weld is dressed if required Suitability: • Due to the fusing of the material using welding the joint if done correctly will be as strong as the rest of the frame. • Robotics and welding jigs allow for mass production and repeatability. Soldering process: • PCB preparation • Component positioned in board • Soldering iron applied • Solder applied to joint when hot • Remaining solder removed before soldering iron retracted. Suitability: • Due to the low melting point of soft solder the PCB will not be deformed or burnt during the process. • The application of solder can be done accurately by hand or by machine. • The separate nature of solder from the copper means that by reheating the joint can be removed with minimal permanent damage to the PCB/components.	2x8	**The use of a bullet pointed list within the response will cap the mark to 4/8 marks per product.** **If reference to a strong MIG welded joint is made then only reward if the point refers to the fusing of the components**

5	10		Mark Bands 0 marks No answer worthy of credit. 1-4 marks The candidate may refer to ease if transport and the benefits to the customer specifically. Specific examples, such as nuts and bolts may be mentioned. 5-8 marks The candidate will recognise benefits for both manufacturer and customer. Reference may be made to KD fittings and diagrams may be used to support the answer. 9-12 marks The candidate will recognise the benefits for both manufacturer and customer, reference to scale of production and mass customisation, such as that seen with Ikea furniture solutions may be referred to. **Indicative content:** • Ease of storage for manufacturer. • Ease of transport for customer. • Use of standardised components. • Interchangeable parts, such as doors etc. • Ability to manufacture most parts using CNC machinery. **This is not an exhaustive list, other relevant points made should be rewarded.**	12	**If the same point is used for an advantage for the customer and the manufacturer then a second mark can only be awarded if further specific explanation is given to differentiate between them.** **Phrases such as 'cheaper' must be expanded to be worthy of credit.**

6	11		Mark Bands 0 marks No answer worthy of credit. 1-4 marks The candidate will refer to the influence of reducing oil availability on either the design or manufacture of motor vehicles. 5-8 marks The candidate will refer to the influence of reducing oil availability on the design and manufacture of motor vehicles, with some explanation. 9-11 marks The candidate explains several developments used in vehicle design and manufacture to reduce the use of crude oil. 12-14 marks The candidate refers in detail to a range of technological developments used in both motor vehicle design and manufacture to reduce the use of crude oil. **Indicative Content:** • Introduction of Hybrid engines. • Reduction in engine size 'Blue Motion'. • Introduction of Electric cars such as Nissan Leaf and Chrysler Volt. • Formula E race series to develop technology further. • Aerodynamic improvements • Engine recovery systems (KERS) used to harness energy during braking. • Hydrogen powered cars **This is not an exhaustive list, other relevant points made should be rewarded.**	14	**Give credit for reference to a specific technology used to reduce use of finite resources.** **Give further credit for an explanation of the technology**

6	12		Mark Bands: 0 marks No answer worthy of credit. 1-4 marks The candidate refers to a single smart material and gives points largely dealing with either energy consumption or safety. 5-8 marks The candidate refers to at least one smart material or two different products using the same material explaining reductions in energy consumption and improved product safety. 9-11 marks The candidate details to at least two smart materials explaining reductions in energy consumption and improved product safety. 12-14 marks The candidate explains three or more specific smart materials and products where energy consumption and product safety have been improved. **Indicative content:** Thermochromic pigments in baby spoons etc. • To increase hygiene as parents no longer need to taste food to check temperature • Reduce risk of scalding as accurate temperature is shown visibly. Thermochromic pigments used in Kettles to: • Reduce waste energy from re-boiling • Give visual clue that the kettle is still hot to deaf and also children as red is commonly associated with hot. Phosphorescent pigments in fire exit signs: • Charge with exposure to light and no electricity needed. • Work without power in a power cut situation. **This is not an exhaustive list, other relevant points made should be rewarded.**	14	**1 mark for an accurate definition of a smart material** **1 mark for naming a specific smart material**