

GCE

Design and Technology: Product Design

Unit **H006**: Principles of Product Design

Advanced Subsidiary GCE

Mark Scheme for June 2018

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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Annotations

<i>Annotation Name</i>	<i>Description</i>
✓	Tick
X	Cross
✓+	Development of point
?	Unclear
BOD	Benefit of doubt
BP	Blank page
L1	Level 1
L2	Level 2
L3	Level 3
NAQ	Not answered question
NBOD	Benefit of doubt not given
OFR	Own figure rule
REP	Repeat
TV	Too vague

Subject Specific Marking Instructions**INTRODUCTION**

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet Instructions for Examiners. If you are examining for the first time, please read carefully Appendix 5 Introduction to Script Marking: Notes for New Examiners.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question			Answer	Mark	Guidance
1	(a)		<p>Possible features include:</p> <ul style="list-style-type: none"> • Carabiner clip so it can be worn on the body or clipped onto a bag (1). • Compact size so it can fit into a pocket (1). • Lightweight so can be easily carried (1). • It is battery powered so it can be used away from a power source (1). • Any other valid suggestion. 	3	<p>One mark for identifying each of three features that make the speaker portable.</p> <p>For a mark to be awarded Fig. 1.1 must be analysed.</p>
1	(b)		<p>Possible reasons include:</p> <ul style="list-style-type: none"> • Lightweight (1) so won't be too heavy to carry about (1). • Good impact resistance (1) so will sustain knocks and bangs if attached to a bag (1). • Resistant to corrosion (1) so won't rust if it gets wet outside/in the shower (1). • Strong (1) so won't bend or mis-shape if clip is pulled/caught (1). • Any other valid suggestion. 	2	<p>One mark for identifying reason why an alloy has been used to manufacture the carabiner clip.</p> <p>One mark for explaining the reason given.</p>
1	(c)	(i)	<p>Possible reasons include:</p> <ul style="list-style-type: none"> • Produces continuous cross-section (1). This gives a consistent diameter for the clip (1). • It is a low-cost process (1). This is because the extrusion machine is existing and just needs new die with the profile to suit the section required (1). • It produces continuous/long lengths (1). This is ideal for a production line (1). • Any other valid suggestion. 	4	<p>In each case:</p> <p>One mark for identifying a reason why extrusion has been used to form the alloy rod.</p> <p>One mark for justifying the reason given.</p> <p>Mix and match approach – i.e. the justification point can relate to a different reason depending on the argument made.</p>

Question		Answer	Mark	Guidance
	(ii)	<p>Possible reasons include:</p> <ul style="list-style-type: none"> • There is no grain flow in the material (1) so the material may have areas of weakness that may cause the clip to fracture or break under stress (1). • High tooling costs for casting (1) which would increase the product cost making profit margins less (1). • Accept: The surface finish would be grainy (if assumption has been made that it is sand casting) (1) making it difficult to create a shiny high quality finish (1). • Any other valid suggestion. 	2	<p>One mark for identifying reason why casting is not a suitable method for the manufacturing of the curved component.</p> <p>One mark for explaining the reason given.</p> <p>As the casting method is not specified candidates should be awarded for explanations referring to either sand or die casting methods.</p>
1	(d) (i)	<ul style="list-style-type: none"> • Anodising (1). • Powder Coating (1). • Any other valid suggestion 	1	For one mark.
	(ii)	<p>Possible advantages include:</p> <ul style="list-style-type: none"> • It makes the surface more durable/resistant to scratches (1). • Helps to prevent against corrosion or decay (1). • Can be used to colour the clip (1). • The finish will not peel or chip (1). • Can still be recycled (1). • Any other valid suggestion. 	2	One mark for identifying each of two advantages of using the finishing process identified in part (i).

Question	Answer	Mark	Guidance
1 (e)*	<p>Indicative content:</p> <p>Ways in which modern technology has influenced the development of products:</p> <p>Possible technologies could include:</p> <ul style="list-style-type: none"> • Bluetooth technology wirelessly transferring data over short distances and linking/pairing devices. • Wireless charging for mobile phones being built into furniture. • W-Fi enabling multiple devices to be connected, e.g. the internet of the things. • USB charging/powering facilitates many devices to be powered from one source where things can be connected and powered through one cable, e.g. speakers and printers. • Voice/fingerprint/face recognition increases security on devices which has helped to develop features such as secure mobile payments. • Near field communication such as contactless payments on mobile phones and debit cards. • Size of cameras enabling them to be integrated into different products like mobile phones. • Cloud storage - e.g. Apple 'iCloud' synchronising contacts, calendar, etc. across all devices of a user. • Connected devices and appliances - e.g. fridges to order items when low stock, connected vehicles automatically dialling emergency services in case of impact, etc. • GPS location technology – e.g. on phones, 	<p style="text-align: center;">8</p> <p>As a guide for full marks there will be two or three different ways in which modern technology has influenced the development of products. The focus should be on modern technologies.</p> <p>If candidates do not provide an analytical/evaluative response then only Level 1 can be awarded.</p>	<p>Levels of response</p> <p>Level 3 (6–8 marks) The candidate produces a thorough discussion of how modern technology has influenced the development of products. The candidate demonstrates a comprehensive understanding of the question by explaining a number of ways that modern technology has influenced product development. When examples of technologies are given they are clearly analysed in terms of the influence they have had.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated with the use of examples.</i></p> <p>Level 2 (3–5 marks) The candidate produces a sound discussion of how modern technology has influenced the development of products. The candidate demonstrates a reasonable understanding of the question by explaining one or more ways that modern technology has influenced product development. When example(s) of technology(ies) are given they are explained in terms of the influence they had had although one or two opportunities for development are missed.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.</i></p> <p>Level 1 (1–2 marks) The candidate demonstrates knowledge of modern technologies with limited awareness of how technology has influenced the development of products. There is no analysis of the influence of technology and any examples</p>

Question	Answer	Mark	Guidance
	<p>cars, etc. On phones gives immediate access to local suppliers, restaurants, etc. through Apps.</p> <ul style="list-style-type: none"> • Any other valid suggestion. 		<p>given, if any, are basic.</p> <p><i>The information has some relevance and is presented with limited structure or detail The information is supported by limited evidence.</i></p> <p>Level 0 (0 marks) No response or no response worthy of credit.</p>

Question		Answer	Mark	Guidance
2	(a)	= <ul style="list-style-type: none"> • $360/3 = 120^\circ$ (1). 	1	For one mark. There is no other valid answer.
2	(b)	(i) <ul style="list-style-type: none"> • Because it is two times/double the radius of 15mm (1). • Any other valid suggestion. 	1	For one mark. There are different ways that a candidate could express their answer. Award marks if intention of candidate is clear.
		(ii) = $2 (1) \times (30 \cos 30) (1) = 2 \times (25.98) = 51.96 \text{ mm} (1).$	3	Award three marks as follows: <ul style="list-style-type: none"> • One mark for multiplying by 2. • One mark for applying the cos. • One mark for correctly solving the equation. <p>If correct answer is given without working out shown award full marks.</p> <p>Working out must be shown in order to award appropriate marks.</p>
		(iii) = $51.96^* + 15 + 15 = 81.96 \text{ mm or } 82 \text{ mm} (1).$	1	For one mark. *Allow error carried forward (ECF) where correct working out is shown.
2	(c)	= A: 69 s (1). B: 87.66s or 86.7s (1).	2	Award two marks as follows: <ul style="list-style-type: none"> • One mark for calculating the mean spin time of Type A. • One mark for calculating the mean spin time of Type B.

Question		Answer	Mark	Guidance
2	(d)	= 6 boxes (1). *6 x 19.90 (1). 6 x 19.90 x 0.95 = £113.43 (1).	3	<i>Award three marks as follows:</i> <ul style="list-style-type: none">• One mark for number of boxes.• One mark for calculating total cost.• One mark for calculating total cost of the order. <p>*Allow error carried forward (ECF) where correct working out is shown.</p> <p>If correct answer is given without working out shown award full marks.</p> <p>Working out must be shown in order to award appropriate marks.</p>

Question		Answer	Mark	Guidance
3	(a)	<p>Indicate content:</p> <p><i>The candidate is expected to demonstrate their understanding of the process involved through a series of annotated sketches and/or notes. There may be variations to the process as indicated but to get into Level 3 candidates must demonstrate a clear understanding of the end to end process.</i></p> <p>Die casting process:</p> <ul style="list-style-type: none"> • The sections of the mould/die are mounted securely in a machine and are arranged so that one is stationary (fixed die half) while the other is moveable (injector die half). • To begin the casting cycle, the two die halves are clamped tightly together by the die casting machine. • Molten metal of a sufficient quantity is injected into the die cavity where it solidifies quickly. • Dies are cooled by water circulating through channels/holes in the dies. • The die halves are drawn apart and the casting is ejected. • Sprues are removed. • The thread can be integrated into the die casting process or added afterwards. 	<p>8</p> <p>All processes demonstrated in the candidate's response must relate to the threaded metal insert. The material, equipment and machinery must be suitable for industrial manufacture.</p> <p>Candidates can draw on practical experience from product analysis and the workshop to support their response to this question.</p>	<p>Levels of response</p> <p>Level 3 (6–8 marks) The candidate will demonstrate a thorough understanding of the process needed to manufacture 7 000 threaded metal inserts with accurate technical terms and detailed consideration of any material, equipment and machinery required. Sketches, if used, will be clear and supported with relevant notes. The process will be end to end and clear in the way it is explained.</p> <p>Level 2 (3–5 marks) The candidate will demonstrate a sound understanding of some aspects of the process needed to manufacture 7 000 threaded metal inserts with reasonable use of technical terms and some consideration of any material, equipment and machinery required. Sketches, if used, will, for the most part, be clear and supported with notes most of which are relevant. The end to end process may contain some gaps in understanding.</p> <p>Level 1 (1–2 marks) The candidate will demonstrate a limited knowledge of the process, applying this knowledge in a basic way to how 7 000 threaded metal inserts would be manufactured, with a limited use of technical terms and basic consideration of any material, equipment and machinery required. Sketches, if used, will be unclear with only basic notes to accompany them. The end to end process may not exist and if anything is basic in nature.</p> <p>Level 0 (0 marks) No response or no response worthy of credit.</p>

Question		Answer	Mark	Guidance
3	(b)	<p>Indicate content:</p> <p><i>The candidate is expected to demonstrate their understanding of the process involved through a series of annotated sketches and/or notes. There may be variations to the process as indicated but to get into Level 3 candidates must demonstrate a clear understanding of the end to end process.</i></p> <p>Expected process to include:</p> <ul style="list-style-type: none"> Producing a former/multiple formers with identification of features that enable the mould to be successful, e.g. draft angles. Safe and correct use of the vacuum former including creating a seal. Correct finishing of mould including trimming and bending of edges. 	5	Levels of response
			<p>All processes demonstrated in the candidate's response must be relation to the shell packaging.</p> <p>All processes outlined should be appropriate for a school/college workshop.</p> <p>Candidates can draw on practical experience from the workshop to support their response to this question.</p>	<p>Level 3 (4-5 marks) The candidate will demonstrate a good level of detail of the process needed to manufacture the shell packaging using technical terms and consideration of any material, equipment and machinery required. Sketches, if used, will be clear and supported with relevant notes. The process includes all relevant stages.</p> <p>Level 2 (2-3 marks) The candidate will demonstrate a sound level of detail of the process needed to manufacture the shell packaging using some technical terms and some consideration of any material, equipment and machinery required. Sketches, if used, will, for the most part, be clear and supported with notes most of which are relevant. The process includes some relevant stages.</p> <p>Level 1 (1 mark) The candidate will demonstrate a limited level of detail of the process needed to manufacture the shell packaging, with a limited use of technical terms and basic consideration of any material, equipment and machinery required. Sketches, if used, will be unclear with only basic notes to accompany them. Few relevant stages are included.</p> <p>Level 0 (0 marks) No response or no response worthy of credit.</p>

Question			Answer	Mark	Guidance
3	(c)	(i)	<p>Possible hazards/control measures include:</p> <ul style="list-style-type: none"> Overheating the plastic will create fumes (1) so use a timer alert (1). User may burn themselves on machine and or plastic (1) so do not touch hood (1) / wear leather gloves (1) / wait for plastic to cool before handling (1) / use a jig to produce the line bends (1). Machine or plastic could start a fire (1) so do not leave unattended (1) / use a timer (1). User may cut themselves when trimming the material (1) so use a safety ruler when using cutting tools/knife (1). Any other valid suggestion. 	4	<p><i>In each case:</i></p> <p><i>One mark for identifying a potential hazard during the manufacture of the packaging.</i></p> <p><i>One mark for specifying a suitable control measure for the identified hazard.</i></p> <p>The control measure must link to the hazard identified to gain the mark.</p> <p>Specific reference to hazards for vacuum forming PVC, trimming the mould and/or using the line bender needed for the marks. Do not credit generic hazards.</p>
		(ii)	<p>Possible reasons include:</p> <ul style="list-style-type: none"> To form the basis for safety teaching/training/supervision/signage/ instructions (1). This should mean there is a reduction in the change of accidents happening (1). Regulators, HSE, insurers and authorities expect and require them (1). It validates for them that employers are exercising their 'duty of care'. Individuals are more aware of the risks when carrying out certain health and safety-related activities. This should hopefully mean they take the preventative actions to minimise these risks (1). Any other valid suggestion. 	2	<p><i>One mark for identifying reason why it is important to carry out risk assessments.</i></p> <p><i>One mark for explaining the reason given.</i></p> <p>Mix and match approach.</p> <p>The expansion point can relate to a different reason depending on the argument made.</p>

Question		Answer	Mark	Guidance
4	(a)	<p>Possible benefits include:</p> <ul style="list-style-type: none"> • Children grow so the scooter can grow (1) with the user so it can be used for longer (1). • Fits different heights of children so different ages, (1) more people can use it in one family (1). • Saves money (1) as children grow quickly as would need larger size (1). • More comfortable (1) to use as can be tailored to fit user (1). • Any other valid suggestion. 	4	<p><i>In each case:</i></p> <p><i>One mark for identifying a benefit to the user of being able to adjust the height.</i></p> <p><i>One mark for justifying the benefit given.</i></p>
4	(b)	<p>Possible responses include:</p> <ul style="list-style-type: none"> • Nylon (1). <ul style="list-style-type: none"> ○ Durable so it could withstand daily wear on different pavements or surfaces without chipping or breaking (1). ○ Tough so it can absorb an impact without fracture, which is important if the scooter is used for jumps or dropped (1). ○ Corrosion resistant so will not break down if left out in the garden/used in the rain (1). ○ Low coefficient of friction so will enable the wheels to run smoothly when in use (1). • ABS (1). <ul style="list-style-type: none"> ○ Durable so it could withstand daily wear on different pavements or surfaces without chipping or breaking (1). ○ Tough so it can absorb an impact without fracture, which is important if the scooter is used for jumps or dropped (1). ○ Can be recycled so at the end of the scooter's life the wheel could be remoulded into a new product and not left for landfill (1). • Any other valid suggestion. 	3	<p><i>One mark for identifying a suitable thermoplastic for the manufacture of the wheel.</i></p> <p><i>Up to two marks for justifying why chosen thermoplastic is suitable for the manufacture of the wheel.</i></p> <p>Single word justifications will not gain marks – i.e. 'durable'.</p>

Question		Answer	Mark	Guidance		
4	(c)	<p>Possible methods include:</p> <ul style="list-style-type: none"> • Triangulation (1): <ul style="list-style-type: none"> ○ Gives the deck more strength (1). ○ Reinforces without increasing the weight (1). • Reinforcing (1): <ul style="list-style-type: none"> ○ Will give it rigidity/stiffness/a degree of 'flexibility' in use (1). ○ Make for more successful moulding because of the consistent 'wall thickness' of the mouldings (1). • Any other valid suggestion. 	2	<p>One mark for identifying method that has been used to ensure the structural integrity of the scooter deck.</p> <p>One mark for identifying on way in which this method will improve the deck's structural integrity.</p>		
4	(d)	(i)		<p>Possible materials include:</p> <ul style="list-style-type: none"> • Nylon (1). • Any other valid suggestion. 	1	<p>For one mark.</p> <p>Material should refer to the surface of the padded sleeve.</p>
		(ii)		<p>Possible reasons include:</p> <ul style="list-style-type: none"> • Resists mildew and bacterial growth so ideal for coating the sleeve as it may be kept outside or in garden sheds (✓). • Reasonably weatherproof as resists water and sunlight as it may be kept outside (✓). • Can be printed on using sublimation printer to get the patterned surface (✓). • Flexible so with the padding provides a cushion for the bar/ prevents damage (✓). • Durable - hard wearing so will with stand daily wear and tear (1). • Any other valid reason. 	1	<p>For one mark.</p> <p>The reason must link to the material identified to gain the mark.</p>
4	(d)	(iii)		<p>=</p> <p>Diameter of the bar is 30 mm Sleeve material is 2 mm thick Outer diameter of sleeve is $30 + 2 + 2 = 34$ mm (1). Outer Circumference of sleeve is $\pi \times 34^* = 106.8$mm (1).</p>	3	<p>Award three marks as follows:</p> <ul style="list-style-type: none"> • One mark for correctly calculating the outer diameter of the sleeve. • One mark for correctly solving the equation to calculate the outer

Question		Answer	Mark	Guidance
		External surface area of sleeve is $106.8 \times 480 = 51270.79\text{mm}^2$ or 51271mm^2 (1).		<p>circumference.</p> <ul style="list-style-type: none"> One mark for correctly calculating the external surface area. <p>*Allow error carried forward (ECF) where correct working out is shown.</p> <p>If correct answer is given without working out shown award full marks.</p> <p>Working out must be shown in order to award appropriate marks.</p>
4	(e)	<p>Possible physical tests include:</p> <ul style="list-style-type: none"> The scooter could be tested to destruction (1) to test: <ul style="list-style-type: none"> impact that the deck can withstand (1). the weight it can hold (1). The scooter deck could be checked for size (1) to ensure it is accurate and fits with the remaining scooter components (1). The scooter could be tested by children/ users (1) to test: <ul style="list-style-type: none"> the grip of the deck (1). the size of the deck (1). Any other valid suggestion. 	6	<p><i>In each case:</i></p> <p><i>Up to two marks for describing a physical test that would be carried out on the scooter deck.</i></p> <p>Do not award marks for tests that would be completed during development or manufacture.</p>
4	(f)	<p>Possible reasons include:</p> <ul style="list-style-type: none"> The opportunity to encourage use for a greater length of time (1), as the user gets older and interests change (1). After a period of use parts will get worn (1) and replacing those parts means saves them money so a new scooter does not need to be purchased (1). If a part breaks it can be easily replaced (1), which avoids the purchase of a new scooter (1). 	4	<p><i>In each case:</i></p> <p><i>One mark for identifying a reason why the scooter would have been designed in a way that many of its parts can be replaced.</i></p> <p><i>One mark for justifying the reason given.</i></p>

Question	Answer	Mark	Guidance
	<ul style="list-style-type: none">• New parts of different colours or patterns can be purchased and fitted to customise the scooter (1) maintaining the users' interest (1).• At the end of the scooter's life it can be re-sold rather than thrown away (1) as parts can be easily obtained which benefits the user and the environment (1).• The manufacturer will benefit as it means they can profit from the sale of parts (1), and the scooter continues to make them money after it has been sold (1).• It increases the brand value (1), as people will have the scooters for longer and see them as value for money (1).• Any other valid suggestion.		

Question		Answer	Mark	Guidance
5	(a)	<p>Possible factors include:</p> <ul style="list-style-type: none"> • Technology being updated (1) meaning that things could work faster/better/be made smaller etc. (1). • Fashion/ trends changing/reflecting the past (1) meaning that certain colours and materials could become popular so designs are updated (1). • Changes in safety legislation (1) lead to products becoming obsolete until they are adapted (1). • Environmental concerns (1) leading to products that can be disassembled for recycling (1). • A need is identified (1) and a product is developed to help solve a problem and/or to help/aid people (1). • Any other valid suggestion. 	6	<p><i>In each case:</i></p> <p><i>One mark for identifying a factor that is influential in the development of a product.</i></p> <p><i>One mark for describing the factor given.</i></p>

Question	Answer	Mark	Guidance
<p>5 (b)*</p>	<p>Indicative content:</p> <p>Ways in which designers and manufacturers could use experts in specific subject areas to support decision making in product design include:</p> <p>Specialists will have up-to-date knowledge, information and training in their field – e.g. latest regulations, standards, legislation, etc.</p> <p>Possible experts and examples discussed could include:</p> <ul style="list-style-type: none"> • Mathematicians could be used to help determine quantities of material or size and scale of products, etc. • Software designers could support development of interfaces, apps, etc. • Engineers could advise on structural problems that arise during development of a product, etc. • Special interest groups oversee and manage specific technologies that may be included, etc. • Environmentalists could give an input suitability of material choice or life cycle assessment, etc. • Philosophers could be called upon for moral or ethical decisions, e.g. for advanced AI, etc. • Any other valid suggestion. 	<p>8</p> <p>As a guide for full marks there will be two or three different ways in which designers and manufacturers could use experts in specific subject areas to support their decision making in product design. The focus should be how different experts are used to support the decision-making process.</p> <p>If candidates do not provide an analytical/evaluative response then only Level 1 can be awarded.</p>	<p>Level 3 (6–8 marks)</p> <p>The candidate produces a thorough discussion of how designers and manufacturers could use experts in specific subject areas to support their decision making in product design. The candidate demonstrates a comprehensive understanding of the question by explaining a number of ways that experts have been used. When examples of how this expertise is used are given this is clearly analysed in terms of the impact they have had on the decision making process.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated with the use of examples.</i></p> <p>Level 2 (3–5 marks)</p> <p>The candidate produces a sound discussion of how designers and/or manufacturers could use experts in specific subject areas to support their decision making in product design. The candidate demonstrates a reasonable understanding of the question by explaining one or more ways that experts have been used. When example(s) of how this expertise is used are given this is explained in terms of the impact they have had on the decision making process although one or two opportunities for development are missed.</p>

Question	Answer	Mark	Guidance
			<p><i>There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.</i></p> <p>Level 1 (1–2 marks) The candidate demonstrates knowledge of experts in specific subject areas with limited awareness of how this expertise has impacted the decision making process in product design. There is no analysis of the impact of experts and any examples given, if any, are basic.</p> <p><i>The information has some relevance and is presented with limited structure or detail The information is supported by limited evidence.</i></p> <p>Level 0 (0 marks) No response or no response worthy of credit.</p>

OCR (Oxford Cambridge and RSA Examinations)
The Triangle Building
Shaftesbury Road
Cambridge
CB2 8EA

OCR Customer Contact Centre

Education and Learning

Telephone: 01223 553998

Facsimile: 01223 552627

Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

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Telephone: 01223 552552
Facsimile: 01223 552553

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