



Oxford Cambridge and RSA

**GCE**

**Design and Technology**

**H406/01: Principles of Product Design**

A Level

**Mark Scheme for June 2022**

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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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## MARKING INSTRUCTIONS

### PREPARATION FOR MARKING

#### RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal <http://www.rm.com/support/ca>
3. Log-in to RM Assessor and mark the **required number** of practice responses (“scripts”) and the **number of required** standardisation responses.

YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

### MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the RM Assessor messaging system, or by email.
5. **Crossed Out Responses**  
Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

#### **Rubric Error Responses – Optional Questions**

Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor,

which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

### Multiple Choice Question Responses

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).

### Contradictory Responses

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

### Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

### Short Answer Questions (requiring a more developed response, worth **two or more marks**)

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

### Longer Answer Questions (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. Award No Response (NR) if:

- there is nothing written in the answer space.

Award Zero '0' if:

- anything is written in the answer space and is not worthy of credit (this includes text and symbols).
- Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.
8. The RM Assessor **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**  
If you have any questions or comments for your team leader, use the phone, the RM Assessor messaging system, or e-mail.
  9. *Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.*
  10. For answers marked by levels of response:
    - a. **To determine the level** – start at the highest level and work down until you reach the level that matches the answer
    - b. **To determine the mark within the level**, consider the following:

Descriptor	Award mark
On the borderline of this level and the one below	At bottom of level
Just enough achievement on balance for this level	Above bottom and either below middle or at middle of level (depending on number of marks available)
Meets the criteria but with some slight inconsistency	Above middle and either below top of level or at middle of level (depending on number of marks available)
Consistently meets the criteria for this level	At top of level

## 11. Annotations

Annotation	Meaning
	Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
	Tick
	Cross
	Confused (replaces the question mark)
	Benefit of doubt
	AO1 – Knowledge and understanding
	AO2 – Apply knowledge and understanding
	AO3 - Analyse
	AO4 - Evaluation
	Omission
	Not answered question
	Noted but no credit given
	Too vague
	Own figure rule
	Repetition

## 12. 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)	i	<p>Possible materials could include:</p> <p>Any suitable <b>thermopolymer</b> such as:</p> <ul style="list-style-type: none"> <li>• ABS</li> <li>• PP</li> <li>• HIPs</li> <li>• Any other suitable response</li> </ul> <p>Acrylic, HDPE are acceptable</p>	1	<p>One mark for identifying a suitable material for the main body of the toothbrush as labelled.</p> <p>Do not accept Silicone or rubber (grips not main body) PET PC ( as it contains BPAs) Thermosetting polymers</p>
		ii	<p>Possible reasons why the material is suitable may include:</p> <ul style="list-style-type: none"> <li>• Chemical resistant so it can be cleaned and sterilised if needed without damage or wear to the surface of the material (1).</li> <li>• Shatter resistant/ high impact resistance so will withstand being dropped and won't shatter becoming a hazard/ break and become unreliable (1).</li> <li>• Any other suitable response.</li> </ul>	2	<p>In each case:</p> <p>One mark per reason why the material identified in part (a)(i) is suitable.</p> <p>Specific reference to the context in the question is needed for marks to be awarded. No marks for simple one/two word responses e.g. 'safer' "durable" 'chemical resistant', reasons should relate to product or use</p>
		iii	<p>Possible responses may include:</p> <p>Over moulding/ two shot moulding (1) One part is injection moulded and then inserted into the mould where the second colour is "over moulded" around the existing part. (1)</p> <p style="text-align: center;"><b>Or</b></p> <p><b>Both parts</b> are injection moulded separately (1) and then snap fittings are used to click/push the parts together /or parts are joined using resin / heat / fused/ bonded together (1)</p>	2	<p>Up to two marks for describing how the handle of the electric toothbrush in Fig. 1.2 would be manufactured to incorporate two different colours of plastic.</p> <p>For two marks detail of how moulds are fitted together is needed if two separate pieces moulded Do not accept adhesive or glue unless specific i.e. DCM/ liquid solvent cement/ Tensol cement/ UF resin</p>

	<b>(b)</b>	<b>i</b>	<p>Possible responses may include:</p> <ul style="list-style-type: none"> <li>Requires no human presence or little human presence, robots carry out the tasks (1)</li> <li>The process can be 24/7 with precision and consistency (1)</li> <li>Any other suitable response.</li> </ul>	<p><b>2</b></p> <p>Up to two marks for describing what is meant by fully automated manufacture.</p> <p>This response can be generic and not in context.</p>
		<b>ii</b>	<p>Possible responses may include:</p> <ul style="list-style-type: none"> <li>Quantity of manufacture is large (1)</li> <li>Need for fast manufacture (1)</li> <li>Cost efficient for high batch run (1)</li> <li>Any other suitable response</li> </ul>	<p><b>1</b></p> <p>One mark for justifying why this process is suitable.</p> <p>This response can be generic and not in context.</p>
	<b>(c)</b>		<p>Possible ways may include:</p> <ul style="list-style-type: none"> <li>A larger diameter handle could be added (1) this would make the design more inclusive to people who have difficulty gripping due to arthritis etc. (1)</li> <li>A larger button area (1) to make the design more accessible for any sized hands or grip. (1)</li> <li>A strap or additional handle (1) would allow it to held for people that are not able to grip (1)</li> <li>A range of different colours or patterns (1) to suit a wider range of users that would have different tastes and styles (1)</li> <li>Any other suitable response.</li> </ul>	<p><b>2</b></p> <p>One mark for giving a way in which it could be more inclusive.</p> <p>One mark for the expansion</p> <p>If two ways are given with no expansion a maximum of one mark can be awarded.</p>
	<b>(d)</b>	<b>i</b>	<p>Possible environmental issues may include:</p> <ul style="list-style-type: none"> <li>The whole toothbrush has to be disposed of after its use and more will need to be produced causing more pollution/ waste in landfill (1). The toothbrush has a limited lifespan as the head of the brush cannot be changed (1).</li> <li>The toothbrush cannot easily be recycled so will end up in landfill (1). This is because it is made of multiple materials in the body, grip and brush (1).</li> </ul>	<p><b>6</b></p> <p>In each case:</p> <p>One mark for identifying an environmental issue that could be caused by the design of the non-electrical toothbrush in Fig 1.1, If improvements are suggested to fig 1.2 then award no marks</p>

		<ul style="list-style-type: none"> <li>The transportation of the toothbrush will increase its carbon footprint (1). This will be frequent as the toothbrush has planned obsolescence so will need replacing frequently (1).</li> <li>The main material of the brush is a polymer which is derived from oil (1). Oil is a finite resource and mining/ processing it has large environmental implications to habitats/ global warming etc (1).</li> <li>Any other suitable response.</li> </ul>		<p>One mark for justifying response given.</p> <p>Specific reference to the context in the question is needed for marks to be awarded.</p> <p>Mix and match of bullet points is possible.</p> <p>Accept positive environmental issues, e.g. no power needed or reduced parts.</p>
	<b>iii</b>	<p>Possible ways may include:</p> <ul style="list-style-type: none"> <li>Maintenance &amp; Repair (1) reducing the waste from planned obsolescence and having repair center that could fix and upgrade components (1).</li> <li>DFM (1). Re-thinking the materials used to find ones that were more suitable and therefore reduced the amount needed etc. (1).</li> <li>Use of recycled or modern bio-degradable and biopolymer material (1). This will reduce the impact as the toothbrush will not end up in landfill (1).</li> <li>Local manufacture (1). This will reduce the need to transport the toothbrush and increase the carbon footprint (1).</li> <li>Re-usable/ replaceable parts (1). To reduce the need for the whole brush to be replaced, for example renewable heads (1).</li> <li>Any other suitable response.</li> </ul>	<b>6</b>	<p>In each case:</p> <p>Up to two marks for explaining a way in which the design of the toothbrushes could be developed to further reduce their environmental impact.</p> <p>Specific reference to the context in the question is needed for marks to be awarded.</p> <p>Mix and match of bullet points is possible.</p> <p>Different ways/methods are needed for each point e.g. material change is one method unless specified for individual components of brush, less parts/components is another way</p>
<b>2</b>	<b>(a)</b>	<p>Possible materials could include:</p> <p>Any suitable metal:</p>	<b>1</b>	<p>One mark for identifying a suitable material</p>

		<ul style="list-style-type: none"> <li>Mild steel (1)</li> <li>Aluminium alloy (1)</li> <li>Any other suitable response.</li> </ul>		Accept Aluminium and stainless steel
	(b)	<p>Suitable coating for the specific metal identified in a:</p> <ul style="list-style-type: none"> <li>Spray painting electrostatically charge (1). Positively charged particles from a specialized gun coat grounded metal surfaces (1).</li> <li>Anodising (aluminium) (1). The aluminium is submerged into an electrolytic bath and a charge is passed through which creates into an aluminium oxide layer which can include colour (1).</li> <li>Any other suitable response for application of a commercial finish.</li> </ul>	2	<p>One mark for identifying a suitable coating.</p> <p>One mark for describing the <b>method of application</b>. Describing or justifying the choice of finish should <b>not</b> be awarded.</p> <p>Answer needs to build on the response candidate provided in 2(a).</p> <p>Do not accept single word answers for example "paint". Accept polymer dip coating, accept galvanising (for steel)</p>
	(c) i	<p>Area of a circle = <math>\pi r^2</math> Diameter of one circle = 20 mm Radius of circle = <math>20/2 = 10</math> (1)</p> <p>Area of one circle = <math>\pi \times 10^2 = \pi \times 100</math> = 314.159265359 mm<sup>2</sup> (1)</p> <p>Total area for 45 holes <math>314.159265359^* \times 45</math> = 14137.1669412 mm<sup>2</sup> (1)</p> <p>If learner has rounded answer then award appropriate credit. 4500 <math>\pi</math> (Max 2 marks – answer requires a full numerical answer) If <math>\pi</math> is rounded up earlier award marks appropriately</p>	3	<p>Award three marks as follows:</p> <p>One mark for determining radius of circle.</p> <p>One mark for calculating area of one hole.</p> <p>One mark for calculating area of 45 holes.</p> <p>If correct answer is given without working out shown award full marks.</p>

				<p>Where an incorrect answer is given working out should be used to credit appropriate marks.</p> <p>*Allow error carried forward (ECF) where correct working out is shown.</p>
		ii	<p>Area of square containing curve section: 30mm x 30mm = 900 mm<sup>2</sup> (1)</p> <p>Formula for calculating curve = <math>\pi r^2 / 4</math></p> <p><math>(\pi(30)^2) / 4 = (\pi \times 900) / 4 = 706.858347058 \text{ mm}^2 (1)</math></p> <p>Waste = <math>(900 - 706.858347058) \times 2 =</math> 193.141652942* (1) mm<sup>2</sup> x 2 = 386.283305885 mm<sup>2</sup> (1) = 386.28 mm<sup>2</sup> (1)</p> <p>If learner has rounded answer then award appropriate credit</p> <p>225 <math>\pi</math> is same value as 706.858347058 so can be awarded 1 mark</p>	<p><b>5</b></p> <p>Award five marks as follows:</p> <p>One mark for calculating area of square containing curve section</p> <p>One mark for calculating the area of the curved section.</p> <p>One mark for calculating waste for one curve.</p> <p>One mark for calculating waste for both curves.</p> <p><b>One mark for rounding answer to 2 decimal places.</b></p> <p>If correct answer is given without working out shown award full marks.</p> <p>Where an incorrect answer is given working out should be used to credit appropriate marks.</p> <p>*Allow error carried forward (ECF) where correct working out is shown.</p>

	<p><b>iii</b> Surface area of music stand (not taking into account holes and curves)</p> <p><math>475 \times (340 + 50) = 475 \times 390</math> (1)  <math>185250 \text{ mm}^2</math> (1)</p> <p><math>185250^* - 14137.1669412^* - 386.283305885^* =</math>  <math>170726.549753 \text{ mm}^2</math> (1)</p> <p>If learner has rounded answer then award appropriate credit.</p> <p><b>If candidate has calculated front and back of stand of stand</b></p> <p><math>= 170726.549753 \text{ mm}^2 \times 2 = 341453.099506 \text{ mm}^2</math></p> <p><b>If candidate has also calculated the surface area of the edge of stand</b></p> <p><math>(475 \times 1) + (475 \times 1) + (390 \times 1) + (390 \times 1) = 1730 \text{ mm}^2</math></p> <p><math>= 341453.099506 + 1730 = 343183.099506 \text{ mm}^2</math></p> <p><b>OR (if front only)</b></p> <p><math>= 170726.549753 + 1730 = 172456.549753 \text{ mm}^2</math></p>	<b>3</b>	<p>Award three marks as follows:</p> <p>One mark for finding the total height of the music holder.</p> <p>One mark for calculating the overall surface area of the music holder.</p> <p>One mark for calculating the overall surface area of the music holder with waste removed.</p> <p>If correct answer is given without working out shown award full marks.</p> <p>Allow for alternative interpretations of question..</p> <p>Where an incorrect answer is given working out should be used to credit appropriate marks.</p> <p>*Allow error carried forward (ECF) where correct working out is shown.</p>
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	<b>(d)</b>	<p>End measurements <math>35 \times 2 = 70</math> (1)          Spaces between holes = 8          Length of holder = 475  <math>(475 - 70^*) / 8 = 50.625</math> mm (1)</p> <p>If learner has rounded answer then award appropriate credit.</p>	<b>2</b>	<p>Award two marks as follows:</p> <p>One mark for calculating the end measurements.</p> <p>One mark for calculating the distance between the centre of each hole.</p> <p>If correct answer is given without working out shown award full marks.</p> <p>Where an incorrect answer is given working out should be used to credit appropriate marks.</p> <p>*Allow error carried forward (ECF) where correct working out is shown.</p>
	<b>(e) i</b>	<p>90% has to be 5% for children age 13, 95% for males</p> <p>Minimum = 640 mm (1)          Maximum = 860 mm (1)</p>	<b>2</b>	<p>Award two marks as follows:</p> <p>One mark for the minimum eye level.</p> <p>One mark of the maximum eye level.</p>
	<b>ii</b>	<p>5%ile eye height for the child age 13 and 95%ile height for male as they give the largest range (1).          Any other suitable response.</p>	<b>1</b>	<p>One mark for appropriate justification.</p> <p>Mark with part (i)</p>
	<b>iii</b>	<p>Average = 50% of all cases</p>	<b>2</b>	<p>Award two marks as follows:</p>

			<p>Children 13-18 = 759 Men = 800 Women = 750</p> <p>Therefore <math>759 + 800 + 750 = 2309</math> (1) Mean = <math>2309 \div 3 = 769.66</math> (2 dec pl) = 770 mm (1)</p>		<p>One mark for adding the 50% value in all cases.</p> <p>One mark for calculating the mean eye level.</p> <p>If correct answer is given without working out shown award full marks.</p> <p>Where an incorrect answer is given working out should be used to credit appropriate marks.</p> <p>*Allow error carried forward (ECF) where correct working out is shown.</p>
3	(a)	i	<p>Possible responses may include:</p> <ul style="list-style-type: none"> <li>• BSI (1)</li> <li>• ISO (1)</li> <li>• Any other suitable response.</li> </ul>	2	<p>In each case:</p> <p>One mark for identifying an organisation that issues standards that need to be met in the design of products.</p> <p>Accept WEEE</p>
		ii	<p>Possible ways may include:</p> <ul style="list-style-type: none"> <li>• To check for levels of toxins (1). Children's toys could have paint scraped off and subjected to x rays to analyse elements in the finish and ensure that levels of elements such as lead are not too high (1).</li> <li>• Cars could be subjected to wind tunnels/ crash tests (1) to check how aerodynamic they are/crumple zones and safety (1).</li> </ul>	4	<p>In each case:</p> <p>Up to two marks for explaining a method/test in which product designers and manufacturers ensure that their products meet relevant standards.</p>

		<ul style="list-style-type: none"> <li>In plastic bottle manufacture the bottles are tested to high pressure blow tests (1) to ensure that there are no cracks or leaks for the air to escape (1).</li> <li>Performance under different conditions</li> <li>Any other suitable response, that could include: <ul style="list-style-type: none"> <li>X rays to check for cracks and internal faults, checks for dimensions of parts to meet standards.</li> </ul> </li> </ul>		Answer will generally use a product to provide supporting context.
(b) *	<p><b>Indicative content:</b></p> <p>Possible discussions of the value of a feasibility study to determine the factors that influence the commercial viability of a product could include:</p> <p>Positive values feasibility studies have positive effect on a product as ensuring the following will create better profits through:</p> <ul style="list-style-type: none"> <li>The design solution's impact on user lifestyle: checks that the product will be beneficial to society, both ethically and safety. Increased sales increase profitability and then feasibility of the product.</li> <li>How well a product performs. The effectiveness of a product, ensure that the consumers are getting a quality product. This can then help the designer and manufacturer make decisions about the design.</li> <li>Technical difficulty of manufacture: This can be modelled on the computer and would have a direct impact on the cost of the product. This can then be assessed.</li> <li>Stock availability: Ability to source material for production, as materials that are hard or from unreliable sources to obtain may well be unsuitable.</li> <li>Costs and profits: Costs of the product and manufacture, hidden costs such a factory and lighting costs, are collated and compared to the price that the customer is charged.</li> </ul> <p>Negative aspects might include:</p> <ul style="list-style-type: none"> <li>Cost of the study may raise the cost of the manufacture.</li> <li>The feasibility study will slow the progress of the product down as it might highlight areas that could be improved.</li> <li>Any other suitable response.</li> </ul>	<p><b>8</b></p> <p>To achieve level 3 candidates should consider the whole product lifecycle. e.g. materials source and manufacturing and associated cost implications.</p> <p>An answer that focuses purely on comparison to other products in the market and market research – marks will be unable to access band 3</p>	<p><b>Level 3 [6-8 marks]</b></p> <p>The candidate has a clear understanding of the value of a feasibility study. They produce a thorough discussion in relation to the question. The explanation of reasons is clear and well-developed and a number of examples are used to exemplify the points being made.</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><b>Level 2 [3-5 marks]</b></p> <p>The candidate has a reasonable understanding of the value of a feasibility study. They produce a reasonable discussion in relation to the question. The explanation of examples is sufficient although one or two opportunities are missed in referring to different examples.</p> <p><i>There is a line of reasoning presented with some structure. The information</i></p>	

				<p><i>presented is for the most part relevant and supported by some evidence.</i></p> <p><b>Level 1 [1-2 marks]</b> The candidate has a basic knowledge of the value of a feasibility study. Any reference to this issue is descriptive in nature and has little appreciation of the aspects involved in a feasibility study and may just focus on one or two aspects and miss opportunities. Examples if any will be limited. The response contains no analysis or evaluation.</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><b>0 marks</b> No answer or answer not worthy of credit.</p>
4	(a)	<p>Possible responses may include:</p> <ul style="list-style-type: none"> <li>• The triangular legs (1) which increase stability and prevent toppling (1).</li> <li>• The additional bracing at the top (1) which strengthens the frame and prevents twisting (1).</li> <li>• Any other suitable suggestion.</li> </ul>	4	<p>In each case:</p> <p>Up to two marks for describing how a feature of the swing seat improves its structural integrity.</p> <p>Specific reference to the context in the question is needed for marks to be awarded.</p>
	(b)	<p>Possible materials could include:</p> <p>Hardwoods:</p>	2	<p>One mark for identifying a suitable hardwood for the manufacture of the swing seat.</p>

		<ul style="list-style-type: none"> <li>• Teak (1) high water-resistance/ natural oil so durable and tough against rot (1)</li> <li>• Oak (1) tough and durable due to dense close grain/ excellent resistant to weather and rot (1)</li> <li>• Iroko (1) dense hardwood that is extremely durable and rot-resistant</li> <li>• Any other suitable response</li> </ul>		<p>One mark for justifying choice of material.</p> <p>Specific reference to the context in the question is needed for marks to be awarded.</p> <p>Do not accept softwoods or manufacture boards, Ash as a hardwood is acceptable but it is not resistant to decay or rot</p>
	(c)	<p>Give details of materials, specialist tooling and quality control checks that would be used.</p> <p><b>Indicative content:</b></p> <p><b>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 L3 candidates must demonstrate a clear understanding of the end to end process.</b></p> <p>Variety of construction techniques can be assumed for this question and there is no “right” answer. Must be suitable for batch of 100, so methods must include production aids to ensure sizes are identical etc.</p> <p>Construction techniques could include consideration that the pack is likely to be purchased flat pack and the side of the seat could be made from one or multiple parts.</p> <p><i>Possible response could include:</i></p> <ul style="list-style-type: none"> <li>• <i>Creation of a cutting jig/ production aid for the slats of the seat base, to ensure consistent length and width.</i></li> </ul>	8	<p><b>Level 3 [6-8 marks]</b></p> <p>The candidate demonstrates a good level of detail of the process needed to manufacture the seat using technical terms and considering any relevant specialist tooling and quality control checks. Sketches, if used will be clear and supported with relevant notes. The process includes all relevant stages.</p> <p><b>Level 2 [3-5 marks]</b></p> <p>The candidate will demonstrate a sound level of detail of the process needed to manufacture the seat using some technical terms and there will be some consideration of any relevant specialist tooling and quality control checks. 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>

	<ul style="list-style-type: none"> <li>• <i>Use of a circular saw, to cut the pieces to size.</i></li> <li>• <i>H&amp;S Use of PPE and training.</i></li> <li>• <i>Pilot holes to be drilled in the slats and supports again using a jig to ensure spacing. Design of the jig/production aid to be detailed. Countersink bit used to create a flush surface with the screw head.</i></li> <li>• <i>Supporting bars to be cut down to size and angled cuts made.</i></li> <li>• <i>Glass paper used to smooth edges if needed.</i></li> <li>• <i>Use of mortise and tenon joint and tool for the arm of the chair.</i></li> <li>• <i>Assembly and testing of a final product to ensure it works &amp; parts are correct.</i></li> <li>• <i>Accept use of CNC machinery.</i></li> </ul> <p>This is an example of a low level 3 response that is clearly presented with technical detail that includes relevant specialist tooling and quality control checks.</p>		<p><b>Level 1 [1-2 marks]</b>                  The candidate will demonstrate a limited level of detail of the process needed to the seat with a limited use of technical terms and there will be a basic consideration of any relevant specialist tooling and quality control checks. Sketches, if used, will be unclear with only basic notes to accompany them. Few relevant stages are included.</p> <p><b>0 marks</b>                  No response or no response worthy of credit.</p>
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18

(c) The swing seat shown in Fig. 4.1 is manufactured as a batch of 100 from hardwood.

Use annotated sketches and/or notes to show how the seat could be manufactured.

Your answer **must** include the following:

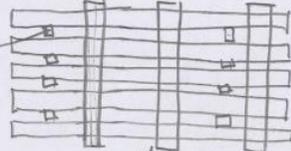
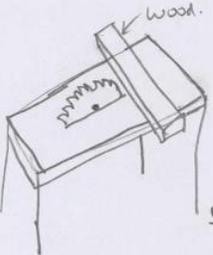
- seat base and back
- seat arms.

Identify any relevant equipment, machinery and materials.

[8]

Long pieces of standard wood are cut to length using a circular saw.  
(10mm x 5mm lengths)

The pieces would be laid on top of vertical pieces cut in the same way with spacers in between



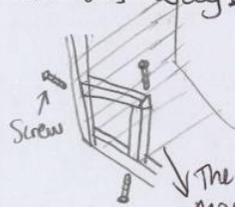
A screw would then be put in to secure the pieces in place.



The back and seat would be made in this way.

\* → The edges of the wood would all be sanded smooth and a sealant applied to the seat for protection.

The arm would be attached using more screws to hold the whole seat together.



L3

	(d)	i	<p>Possible materials may include:</p> <p>Metals:</p> <ul style="list-style-type: none"> <li>• Mild steel (1) as it has a high tensile strength so will withstand the load, without failing (1).</li> <li>• Any other suitable response, e.g. stainless steel</li> <li>• .</li> </ul>	2	<p>One mark for identifying a suitable metal for the manufacture of the chain.</p> <p>One mark for justifying chosen material.</p> <p>Specific reference to the context in the question is needed for marks to be awarded.</p>
		iii	<p>Possible materials may include:</p> <p>Synthetic fibres:</p> <ul style="list-style-type: none"> <li>• Polyester (1)</li> <li>• Polypropylene (1)</li> <li>• Nylon (1)</li> <li>• Any other suitable response</li> </ul>	1	<p>One mark for identifying a synthetic fibre that could be used in the form of a rope to hang the swing seat from the frame.</p> <p>Specific reference to the context in the question is needed for marks to be awarded.</p> <p>Carbon fibre/ Kevlar/ ABS are accepted responses</p>
	(e)		<p>The designer of the swing seat needs an awareness of sustainability issues relating to industrial manufacture.</p> <p><b>Indicate content:</b></p> <ul style="list-style-type: none"> <li>• Materials: <ul style="list-style-type: none"> <li>○ Source of material. Candidates could discuss the use of sustainability sources timber from FSC approved forests, or the use of locally</li> </ul> </li> </ul>	6	<p><b>Level 3 [5-6 marks]</b></p> <p>The candidate has a clear understanding of the sustainability issues the designer will have to consider. They produce a thorough discussion in relation to the question. The explanation of reasons is clear and well-developed, and a number of</p>

		<p>sourced materials. They could consider the impact of using more suitable outdoor timbers that are less sustainable to produce a product that is more hardwearing or naturally weatherproof.</p> <ul style="list-style-type: none"> <li>○ End of life: The use of natural materials and ease of disassembly and separation of parts means could be considered to ensure users could dispose of the products.</li> <li>● Manufacturing             <ul style="list-style-type: none"> <li>○ Efficiency: Candidates could discuss the efficiency of production lines and use of Design for manufacture principles to maximise sustainability.</li> <li>○ Transport and packaging. Ability to be transported without damage with minimal packaging and waste material.</li> </ul> </li> <li>● Design             <ul style="list-style-type: none"> <li>○ Reducing material, optimising design. Candidates could discuss the advantage of making the design from separate parts that could extend the useful life, as parts could be replaced or updated when needed/ wanted.</li> <li>○ Replacement parts/ ease of repair. The use of standardised parts could be considered to ensure that the life of the product will exceed the life of the company. Enabling users to fix or replace parts locally.</li> <li>○ Any other suitable response.</li> </ul> </li> </ul>		<p>examples are used to exemplify the points being made.</p> <p><b>Level 2 [3-4 marks]</b>          The candidate has a reasonable understanding of the role of the sustainability issues the designer will have to consider. They produce a reasonable discussion in relation to the question. The explanation of examples is sufficient although one or two opportunities are missed in referring to different examples.</p> <p><b>Level 1 [1-2 marks]</b>          The candidate has a basic knowledge of the role of the sustainability issues the designer will have to consider. Any reference to this issue is descriptive in nature and has little appreciation of the implications of increasing the use of alternative renewable energy sources. The response contains no analysis or evaluation.</p> <p><b>0 marks</b>          No answer or answer not worthy of credit.</p>
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