



Cambridge International AS & A Level

DESIGN AND TECHNOLOGY

9705/32

Paper 3 Written 32

May/June 2022

MARK SCHEME

Maximum Mark: 120

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

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This document consists of **16** printed pages.

PUBLISHED**Generic Marking Principles**

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

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Question	Answer	Marks	Guidance
Section A			
Part A – Production Design			
1(a)	suitable material: <ul style="list-style-type: none"> • aluminium alloy, brass • hardwood, e.g. beech • abs, acrylic <p style="text-align: right;">1</p> reasons: <ul style="list-style-type: none"> • turns well, good finish • will resist regular handing without breaking <p style="text-align: right;">1 × 2</p>	3	<i>Accept any other suitable material or any other reason appropriate to material choice</i>
1(b)	quality of description: <ul style="list-style-type: none"> • fully detailed all/most stages • some detail, • quality of sketches <p style="text-align: right;">4–7 0–3 up to 2</p>	9	<i>Dependant on material chosen.</i> <i>Turned hardwood, drilled, slot shape cut (routed), finished</i> <i>ABS, acrylic cut (laser), shaped, finished, cemented</i> <i>Aluminium alloy, brass turned, slot shape cut, (milled), finished</i> <i>Must show shaping, drilling and slot shape cut out</i>

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Question	Answer	Marks	Guidance
1(c)	<p>explanation could include:</p> <ul style="list-style-type: none"> change in process; change in materials; use of jigs, formers, moulds; simplification of design. <p>quality of explanation:</p> <ul style="list-style-type: none"> logical, structured 4–6 limited detail, 0–3 <p>quality of sketches up to 2</p>	8	<p><i>Jigs, templates for drilling and cutting slot shape</i></p> <p><i>Multiple turned holders, cnc lathe.</i></p> <p><i>Injection moulding not appropriate for batch of 50 – award up to 3 marks for full description of producing holder using injection moulding</i></p>

Question	Answer	Marks	Guidance
2	<p>Discussion could include:</p> <ul style="list-style-type: none"> fixed and variable costs, production methods of selected items quantity production implications machine-made, hand-made <p>examples / evidence could be</p> <ul style="list-style-type: none"> specific fixed and variable costs, specific processes specific materials <p>examination of issues</p> <ul style="list-style-type: none"> wide range of relevant issues 4–8 limited range 0–3 <p>quality of explanation</p> <ul style="list-style-type: none"> logical, structured 4–8 limited detail, 0–3 <ul style="list-style-type: none"> supporting examples / evidence 4 	20	<p><i>A unit cost is a total expenditure incurred by a company to produce, store, and sell one unit of a particular product or service.</i></p> <p><i>Fixed costs – rent, insurance, and equipment, such as warehousing and the use of production equipment.</i></p> <p><i>Variable costs vary depending on the level of output produced. These expenses have a further division into specific categories such as direct labour/salaries and direct material costs. Sourcing materials can improve variable costs from the cheapest supplier or by outsourcing stages such as production, transport and marketing.</i></p> <p><i>Two of the required items must be discussed in detail to achieve full marks</i></p>

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Question	Answer	Marks	Guidance
3(a)	description of process <ul style="list-style-type: none"> • fully detailed, all/most stages 3–5 • some detail, 0–2 • quality of sketches up to 2 2 × 7 	14	<p>Vacuum forming</p> <ul style="list-style-type: none"> • prepare former, high-quality finish • fine holes drilled for 6 indents • place former in machine, secure HIPS sheet • apply heat, when ready blow up slightly • apply vacuum • cool, remove, trim <p>Aluminium extrusion</p> <ul style="list-style-type: none"> • secure pre-heated aluminium billet in extruder • fix appropriate die securely • at correct temperature, apply pressure to billet to force through die • extrusion guided on to run out table • length sheared/cut • allow extrusion to cool to room temperature • sheared/cut to desired lengths as required <p>Turning and boring</p> <ul style="list-style-type: none"> • prepare wood to fix on lathe • turn between centres to desired shape, gouges, skew chisel, scrapers, • parting tool as appropriate • turn abrade to high quality finish • apply sealer, beeswax carnauba or other appropriate finish • replace live centre with hollow live centre • bore through with long hole boring bit (accept accurately bored on pillar drill with long drill) • replace cope, cut pouring basin to sprue • final finish <p>Accept any other correct variations or methods</p>

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Question	Answer	Marks	Guidance
3(b)	vacuum forming <ul style="list-style-type: none"> • complex shapes formed • very quick once original former produced • repeated production extrusion <ul style="list-style-type: none"> • accurate cross section • efficient, no waste • once die cut, very rapid production • limited finishing required turning and boring <ul style="list-style-type: none"> • all processes can be carried out on one machine • wide range of cylindrical shapes produced • high quality finish • very quick process <div style="text-align: right;">2×3</div>	6	

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Question	Answer	Marks	Guidance
Part B – Practical Technology			
4	<p>Benefits could be:</p> <p>Electrical</p> <ul style="list-style-type: none"> • range of power supply, mains, battery, solar panel • variation in force/speed of motion easily achieved <p>Mechanical</p> <ul style="list-style-type: none"> • direct or friction drive • maintenance/repair possible <p>Drawbacks could be:</p> <p>Electrical</p> <ul style="list-style-type: none"> • some risk of electrocution • very large forces may require cable although great improvement in battery power • variation in force/speed of motion easily achieved <p>Mechanical</p> <ul style="list-style-type: none"> • noisy, possibly heavy components • limited speed or force generation 	20	<i>To access full marks, candidates must explain the benefits and drawbacks of both electrical and mechanical ways of achieving force and motion in a system or product.</i>

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Question	Answer	Marks	Guidance
4	<p>Examples of application could be</p> <p>Clear understanding of electrical force and motion 5–6 Some understanding of electrical force and motion 3–4 Limited understanding of electrical force and motion 0–2</p> <p>Clear understanding of mechanical force and motion 5–6 Some understanding of mechanical force and motion 3–4 Limited understanding of mechanical force and motion 0–2</p> <p>quality of explanation</p> <ul style="list-style-type: none"> • logical, structured 3–4 • limited detail, 0–2 <p>appropriate use of examples 2 × 2</p>		

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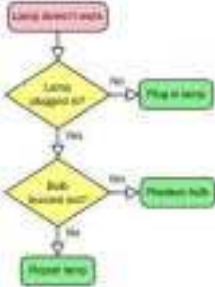
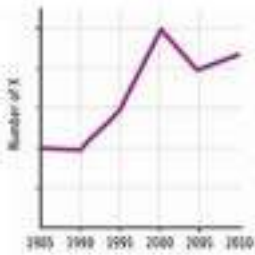

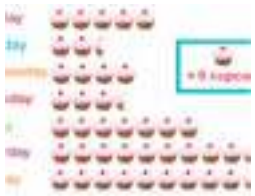
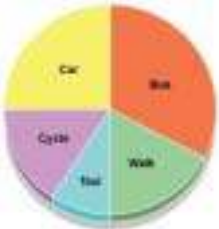
Question	Answer	Marks	Guidance
5(a)(i)	<p>A LDR (Light Dependent Resistor) 1 Senses light, changes resistance 1</p> <p>B Potentiometer 1 Adjusts sensing level 1</p> <p>C Transistor 1 Switch motor on when set light level is reached 1</p> <p>D Diode 1 Protects the transistor from back emf. 1</p>	8	
5(a)(ii)	2 kΩ resistor reduces resistance 1 to protect the transistor 1	2	
5(b)	<p>Discussion could include:</p> <ul style="list-style-type: none"> • product history focus • renew materials/technology available • innovation in range of areas, media, advertising • cost benefits • customer benefits/drawbacks (phones not updated) <p>examples / evidence could be</p> <ul style="list-style-type: none"> • specific products • specific innovatory practice AI, expansion of internet of things • specific examples of product evolution, mobile phones, TVs, computers <p>examination of issues</p> <ul style="list-style-type: none"> • wide range of relevant issues 3–4 • limited range 0–2 <p>quality of explanation</p> <ul style="list-style-type: none"> • logical, structured 3–4 • limited detail, 0–2 <p>supporting examples / evidence 2</p>	10	

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Question	Answer	Marks	Guidance
6(a)(i)	<p>description of process: Hard soldering (brazing)</p> <ul style="list-style-type: none"> • fully detailed, all/most stages 3–4 • some detail, limited stages 0–2 <p>quality of sketches 0–2</p>	6	<p>Hard soldering</p> <ul style="list-style-type: none"> • <i>prepare/clean bar and section</i> • <i>apply flux</i> • <i>place in hearth, surround with fire bricks</i> • <i>wear protective equipment</i> • <i>heat joint until almost yellow, 800°+</i> • <i>apply brazing spelter until it runs</i> • <i>allow to cool</i>
6(a)(ii)	<p>description of process: Soft soldering</p> <ul style="list-style-type: none"> • fully detailed, all/most stages 3–4 • some detail, limited stages 0–2 <p>quality of sketches 0–2</p>	6	<p>Soft soldering</p> <ul style="list-style-type: none"> • <i>clean track/location on PCB</i> • <i>insert or locate resistor on PCB</i> • <i>prepare soldering iron</i> • <i>wear protective equipment</i> • <i>heat joint area with tip of soldering iron</i> <p><i>apply solder, wait for flow, remove solder, remove iron</i></p>
6(b)	<p>Advantages could be:</p> <ul style="list-style-type: none"> • joint not seen • usually quick operation <p>examples could :</p> <ul style="list-style-type: none"> • furniture, rather than screws • aero engine components – reduce weight <p>quality of explanation</p> <ul style="list-style-type: none"> • logical, structured 4–6 • limited detail, 0–3 <p>examples 2</p>	8	

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Question	Answer	Marks	Guidance
Part C – Graphic Products			
7(a)	suitable material: <ul style="list-style-type: none"> • modelling card • acrylic, HIPS, foam board • MDF, balsa reasons: <ul style="list-style-type: none"> • lightweight • easy to cut/shape without workshop tools • appropriate finishes (paint, paper) applied materials 2 relevant and detailed reasoning 3	5	One appropriate material 1 mark Two or more appropriate materials for 2 marks
7(b)	quality of description: <ul style="list-style-type: none"> • fully detailed, all key stages 10–12 • most detail and stages included 7–9 • limited detail 4–8 • few or no stages described 0–3 quality of sketches up to 3	15	<i>Stages could include:</i> <ul style="list-style-type: none"> • sides and base marked to an appropriate scale • accurately cut, including window • surface finish can be applied • sides and base folded, joined in place • cutting window unit will help maintain the curved wall • make bed unit and attach • make wall table unit and attach • attach see through polymer on outside of window <i>apply any other additional detail</i>

Question	Answer	Marks	Guidance
8	<p>Explanation could include flow chart – chart showing logical order of process</p> <p>graph – a diagram showing the relation between variable quantities, typically of two variables, each measured along one of a pair of axes at right angles</p> <p>Ideogram – graphic or written symbol that represents an idea, concept or object directly rather than a particular word or speech sound.</p> <p>pictogram– a chart that uses pictures to represent data or information. Pictograms can be set out in the same way as bar charts, but instead of bars they use columns of pictures to show the numbers involved.</p> <p>pie chart – a way of showing information about how a total amount is divided up, consisting of a circle that is divided from its centre into several parts.</p> <p>quality of explanation:</p> <ul style="list-style-type: none"> • logical, structured 3–4 • limited detail, 0–2 <p>quality of sketches 4 × 4 up to 4</p>	20	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>flow chart</p> </div> <div style="text-align: center;">  <p>graph</p> </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div style="text-align: center;">  <p>ideogram</p> </div> <div style="text-align: center;">  <p>pictogram</p> </div> </div> <div style="text-align: center; margin-top: 20px;">  <p>pie chart</p> </div> <p>Pictograms tend to be more <u>literal</u>. For example, the no parking symbol consisting of a black letter P inside a red circle with a slanting red line through it is an ideogram. It represents the idea of no parking abstractly. A no parking symbol showing an automobile being towed away is more literal, more like a pictogram</p>

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Question	Answer	Marks	Guidance
9	<p>Discussion could include:</p> <ul style="list-style-type: none"> • fashion and style trends • target markets • awareness of market / customer needs • cost implications <p>examples / evidence could be</p> <ul style="list-style-type: none"> • specific designers • specific examples of fashionable/stylish products • specific methods of market awareness, e.g. social media trends, surveys, competitor performance <p>examination of issues</p> <ul style="list-style-type: none"> • wide range of relevant issues 4–8 • limited range 0–3 <p>quality of explanation</p> <ul style="list-style-type: none"> • logical, structured 4 - 8 • limited detail, 0–3 <p>supporting examples / evidence 4</p>	20	

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Question	Answer	Marks	Guidance
Section B			
10, 11, 12	<p>Analysis Analysis of the given situation/problem. 0–5 Detailed written specification of the design requirements. 0–5 At least five specification points other than those given in the question.</p> <p>Exploration B <i>Bold sketches and brief notes to show exploration of ideas for a design solution, with reasons for selection.</i></p> <ul style="list-style-type: none"> • range of ideas 0–5 annotation related to specification 0–5 marketability, innovation 0–5 evaluation of ideas, selection leading to development 0–5 communication <p>Development <i>Bold sketches and notes showing the development, reasoning and composition of ideas into a single design proposal. Details of materials, constructional and other relevant technical details.</i></p> <ul style="list-style-type: none"> development 0–5 reasoning 0–5 materials 0–3 constructional detail 0–7 communication 0–5 	80	

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Question	Answer	Marks	Guidance
10, 11, 12	<p>Proposed solution <i>Produce drawing/s of an appropriate kind to show the complete solution.</i></p> <p>proposed solution 0–10 details/dimensions 0–5</p> <p>Evaluation Written evaluation of the final design solution. 0–5</p>		