



*Rewarding Learning*

**General Certificate of Secondary Education  
2023**

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## **Technology and Design**

Unit 2

Option C: Product Design

**[GTY23]**

**TUESDAY 20 JUNE, MORNING**

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# **MARK SCHEME**

## **General Marking Instructions**

### ***Introduction***

Mark schemes are intended to ensure that the GCSE examinations are marked consistently and fairly. The mark schemes provide markers with an indication of the nature and range of candidates' responses. The mark schemes should be read in conjunction with these general marking instructions.

### ***Assessment objectives***

Below are the assessment objectives for **GCSE Technology and Design**.

Candidates must:

- AO1 Recall, select and communicate their knowledge and understanding of Technology and Design in a range of contexts;
- AO2 Apply skills knowledge and understanding, including quality standards in a variety of design contexts. Plan and carry out investigations and making tasks involving an appropriate range of tools, equipment, materials and processes; and
- AO3 Analyse and evaluate evidence, design proposals and outcomes, make reasoned judgements and present conclusions and recommendations.

### ***Quality of candidates' responses***

In marking the examination papers, examiners should be looking for a quality of response reflecting the level of maturity which may reasonably be expected of a 16-year-old which is the age at which the majority of candidates sit their GCSE examinations.

### ***Flexibility in marking***

Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses which candidates may produce. In the event of an unanticipated answer, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, then examiners should seek the guidance of the Supervising Examiner.

### ***Positive Marking***

Examiners are encouraged to be positive in their marking, giving appropriate credit for what candidates know, understand and can do rather than penalising candidates for errors or omissions. Examiners should make use of the whole of the available mark range for any particular question and be prepared to award full marks for a response which is as good as might reasonably be expected of a 16-year-old GCSE candidate.

### ***Awarding zero marks***

Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

### ***Types of mark schemes***

Mark schemes for tasks or questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

### **Levels of response**

Tasks and questions requiring candidates to respond in extended writing are marked in terms of levels of response. In deciding which level of response to award, examiners should look for the ‘best fit’ bearing in mind that weakness in one area may be compensated for by strength in another. In deciding which mark within a particular level to award to any response, examiners are expected to use their professional judgement. The following guidance is provided to assist examiners.

- **Threshold performance:** Response which just merits inclusion in the level and should be awarded a mark at or near the bottom of the range.
- **Intermediate Performance:** Response which clearly merits inclusion in the level and should be awarded a mark at or near the middle of the range.
- **High Performance:** Response which fully satisfies the level description and should be awarded a mark at or near the top of the range.

### **Marking calculations**

In marking answers involving calculations, examiners should apply the “own figure rule” so that candidates are not penalised more than once for a computational error.

### **Quality of written communication**

Quality of written communication is taken into account in assessing candidates’ responses to all tasks and questions that require them to respond in written form. These tasks and questions are marked on the basis of levels of response. The description for each level of response includes reference to the quality of written communication.

For conciseness, quality of written communication is distinguished within levels of response as follows:

Level 1: Quality of written communication is limited.

Level 2: Quality of written communication is satisfactory.

Level 3: Quality of written communication is very good.

In interpreting these level descriptions, examiners should refer to the more detailed guidance provided below:

**Level 1 (Limited):** The level of accuracy of presentation, spelling, punctuation and grammar is limited. The candidate makes a limited selection and use of an appropriate form and style of writing. The organisation of material may lack clarity and coherence. There is little use of specialist vocabulary.

**Level 2 (Satisfactory):** The level of accuracy of presentation, spelling, punctuation and grammar is satisfactory. The candidate makes a satisfactory selection and use of an appropriate form and style of writing supported with appropriate use of diagrams as required. Relevant material is organised with some clarity and coherence. There is some use of specialist vocabulary.

**Level 3 (Very Good):** The level of accuracy of presentation, spelling, punctuation and grammar is very good. The candidate successfully selects and uses the most appropriate form and style of writing, supported with precise and accurate use of diagrams where appropriate. Organisation of relevant material is very good. There is very good use of appropriate specialist vocabulary.

			AVAILABLE MARKS
1	<p><b>(a)</b> A=Mortice and Tenon joint [1]            B=Comb or Finger joint [1]            C=Dovetail joint [1]            D=Biscuit joint [1]            E=Lap or T halving joint or cross lap [1]            (5 × [1])</p>	[5]	
	<p><b>(b)</b> X=Tenon [1]            Y=Mortice [1]</p>	[2]	
	<p><b>(c) (i)</b> Any <b>two</b>:            The interlocking parts or combs of joint B are cut straight or parallel to the length. [1]            B can be pulled apart more easily [1]            The interlocking parts or dovetails of joint C are cut at an angle. [1]</p>	[2]	
	<p><b>(ii)</b> Any <b>one</b>:            Joint C is much stronger than joint B because of the taper cuts.            Larger gluing area [1]</p>	[1]	10
2	<p><b>(a)</b> One-off/jobbing: This is when only one product is made [1]            Reason: Special commission            Prototype            Any (1 × [1])</p> <p><b>All relevant, valid responses will be given credit.</b></p> <p>Batch: This is when a set number of products are manufactured [1]            Reason: The market will only support a limited number of products            Limited edition of something, e.g. coins            Specialist production runs, e.g. vehicles            Any (1 × [1])</p> <p><b>All relevant, valid responses will be given credit.</b></p> <p>Mass: Large number (Thousands) of products produced [1]            Reason: High market demand for a product            Lowers production cost for manufacturer            Lowers costs for consumer            Economy of production            Any (1 × [1])</p> <p><b>All relevant, valid responses will be given credit.</b></p>	[2]	
	<p><b>(b)</b> Jigsaw: to cut specific shapes/complex shapes/curves in material [1]            Planer: To produce a specific width/thickness or to produce a smooth finish or remove a thin layer of material [1]</p>	[2]	8
	<p><b>All relevant, valid responses will be given credit.</b></p>		

- 3 (a) Exploring possibilities from a given design theme is important as it:
- Provides the opportunity to identify and analyse a design opportunity.
  - Enables the designer to apply research and analytical skills.
  - Enables a designer to identify and analyse key design features of existing solutions.
  - Enables a designer to work from a broad theme and narrow it down to a specific design idea.
  - Enable the designer to be creative.
  - Enable the designer to look at lots of general ideas.
  - Enables the designer to research existing solutions within a general theme.
  - Enables a designer to comment on existing solutions and nurture/germinate early ideas.
  - Helps the designer to narrow the focus towards a specific design idea.
  - Enables the designer to start to focus on a specification.
  - Enables the designer to arrive at a specific design idea.
- Any (3 × [1]) [3]

**All relevant, valid responses will be given credit.**

- (b) The use of freehand graphical techniques and the addition of annotation to develop initial design concepts are important as:
- Freehand graphical techniques enable the user to focus spontaneously on ideas without the need for accuracy.
  - Freehand graphical techniques enable the user to transfer thinking and get ideas/concepts down on paper quickly.
  - Freehand graphical techniques avoid the need to spend time focussing on producing formal drawings.
  - Annotation is important as it can add clarity to concept sketches and drawings.
  - Annotation needs to be brief/succinct.
  - Too much written information can detract from the thought process, communication of ideas or concept sketches.
  - Annotation highlights the designer's thoughts on an aspect/s of concept sketches.
  - Make changes to design ideas quickly.
- Any (3 × [1]) [3]

**All relevant, valid responses will be given credit.**

- (c) The use of physical models or mock ups are important as they:
- Give a designer a realistic idea of sizes and proportion.
  - Provide a good representation of the overall appearance of the product.
  - Can reveal to the designer flaws in a design solution.
  - Can enable a designer to see if modifications are required.
  - Can enable a designer to consider modifications to a product.
  - Can enable a designer to show a solution to a client.
  - Can be used to test the operation of a product.
- Any (3 × [1]) [3]

**All relevant, valid responses will be given credit.**

- 4 (a) (i) Any **four** from:
- Stability
  - It has the aesthetic of a classic café chair e.g. curved lines
  - Recyclable materials used
  - Visually lightweight
  - Stackable
  - Sustainable
  - Strength
  - Simplistic design
  - Range of colours
  - Curved back on the chair
  - Foot rest on the stool
  - Hole in the seat
- (4 × [1]) [4]

**All relevant, valid responses will be given credit.**

- (ii) Form follows Function/Function over Form [1]

- (iii) Any **three** from:
- Fibreglass produces a strong structure
  - Recyclable materials used which reduces landfill
  - Preserves precious raw materials
  - Produces a lightweight product
  - Less expensive to manufacture
  - Cost of raw material is reduced
  - Material availability
  - Suitable for industrial processing/can be shaped
  - Sustainably made/low carbon footprint/good for the environment
- (3 × [1])

**All relevant, valid responses will be given credit.** [3]

- (iv) Any **one** from:
- Mass production reduces costs
  - Produces affordable products
  - There is a specific need for such a product in society
- (1 × [1]) [1]

**All relevant, valid responses will be given credit.**

- (v) Technology Push is when a technological advance such as new materials pushes the development of new products. [1]

AVAILABLE  
MARKS

10

5 (a) (i) Oak, Beech, Mahogany

AVAILABLE  
MARKS

**All relevant, valid responses will be given credit.** [1]

(ii) Any **one** from:

- Grain gives good appearance
- Colour
- Strength, in terms of stability if seasoned well
- Close grained, does not split easily
- Good working characteristics
- Durable

(1 × [1])

**All relevant, valid responses will be given credit.** [1]

(b) (i) Calculation

$205 \times 2$  planks =  $410 \times 2500$  mm panel [1]

$2500/600 = 4$  doors per 2 planks [1]

$4 \times 4 = 16$  doors obtained [1] [3]

(ii) Waste material:

$100 \times 410 \times 4 = 164,000$

+  $2400 \times 10 \times 4 = 96,000$

=  $260,000 \text{ mm}^2$  [2]

Total Material =  $2500 \times 410 \times 4 = 4,100,000 \text{ mm}^2$  [1]

Therefore  $26000/4100000 \times 100 = 6.34\%$  [1]

Or Waste material:

$10 \times 41 \times 4 = 1,640$

$240 \times 1 \times 4 = 960$

$2600 \text{ cm}^2$  [2]

Total Material =  $250 \times 41 \times 4 = 41,000 \text{ cm}^2$  [1]

Therefore  $2600/41000 \times 100 = 6.34\%$  [1]

Note: Multiplying by 4 is optional [4]

(c)

<b>Response Type</b>	<b>Description</b>	<b>Mark Band</b>
When a response is not worthy of credit, <b>[0]</b> should be awarded		
<b>Limited</b>	Student produces sketches which do not convey a clear solution and show limited ideas. The construction lacks detail. The level of annotation conveys limited information and lacks technical vocabulary and specialist terms.	<b>[1]–[3]</b>
<b>Satisfactory</b>	Student produces satisfactory sketches which convey some ideas of the solution. The construction details are generally satisfactory. The level of annotation is satisfactory and contains some technical vocabulary and specialist terms.	<b>[4]–[7]</b>
<b>Very Good</b>	Student produces very good sketches which clearly convey most or all of the design solution. The construction details are generally very good. The level of annotation and technical vocabulary and specialist terms is generally very good.	<b>[8]–[10]</b>

[10]

19

<b>AVAILABLE MARKS</b>

- 6 (a) Glass reinforced Plastic [1]  
Carbon Fibre [1] [2]
- (b) A material that reacts to an external stimulus [1] which causes the shape or behaviour of the material to change [1].  
(2 × [1]) [2]

**All relevant, valid responses will be given credit.**

- (c) **Glass reinforced Plastic (GRP)**
- Has a good strength to weight ratio [1].
  - Very suitable for use in products where weight plays an important factor, for example in canoe /boat/aircraft construction [1].
  - It is constructed around a mould and will easily take up the shape of the mould [1].
  - Easy to cut and drill [1].
  - Non-conductor of electricity [1].
- (2 × [1]) [2]

**All relevant, valid responses will be given credit.**

**Polymorph**

- A material that softens when heated at low temperatures [1].
  - Granules can be softened and fused together [1].
  - It is a thermoplastic [1].
  - Easy to form or shape or reshape in the hand [1].
  - It is a valuable material for designing products where anthropometrics is important [1].
- (2 × [1]) [2]

**All relevant, valid responses will be given credit.**

**Shape memory alloy (nitinol)**

- Very flexible material which can be easily shaped [1]
  - It will return to its original position over time [1]
  - It has a shape memory that is retained over time [1]
  - Can be 'programmed' to work or actuate in a particular way [1]
  - Reacts to temperature changes [1]
  - Corrosion resistant [1]
- (2 × [1]) [2]

**All relevant, valid responses will be given credit.**

AVAILABLE  
MARKS

10

- 7 (a) Any **two** from:  
 Reduces the amount of plastic waste going to landfill.  
 Save earth's resources.  
 Preserves oil reserves.  
 Reduces plastic litter/pollution.  
 Reuses precious resources.  
 (2 × [1]) [2]

**All relevant, valid responses will be given credit.**

- (b) Discussion which focuses on any **two** from:
- how to lift and carry the container [1] by incorporating some sort of handle into the solution. [1]
  - the capacity of the container [1] to suit a specific group of people bearing in mind the limited shelf life of fresh milk, e.g. a family rather than an individual. [1]
  - the size and shape of the container [1] to make it suitable for easy storage in a fridge, or stacking in a supermarket, or stability. [1]
  - the size and shape of the container [1] to make it suitable for ease of transporting from factory to supermarket. [1]
  - limiting the amount of plastic required to make the container [1] but ensuring that it can hold the milk without collapsing or breaking. [1]
  - need to consider the shape at the top [1] to enable ease of pouring. [1]
  - colour of the lid [1] to indicate the type of milk. [1]
  - texture on lid [1] allows grip/ease of opening. [1]
- (4 × [1]) [4]

**All relevant, valid responses will be given credit.**

- (c) **Four** of the main stages (in order) in the blow moulding process.  
 Soften the plastic.  
 Produce/create a parison of soft plastic.  
 Create a hole at the top of the parison.  
 Parison lowered into open mould.  
 Mould closes.  
 Air blown into parison.  
 Molten plastic take up the internal shape of the mould.  
 Plastic cools and hardens.  
 Mould splits/opens.  
 Product/Plastic container is ejected.  
 (4 × 1) [4]

- (d) £190 per 1000 litres = 19 pence per litre [1]  
 Two litres = 19 × 2 = 38 pence [1]  
 38 + 3 = 41 [1]  
 £1.19 – 41 = 78 pence profit on each 2 litre container of milk [1]
- Or** £190 × 1000 = £190000 (for 500 2 litre containers) [1]  
 Costs £190  
 (0.03 × 500) = £15 Total Costs £205 Sale value = 500 × £1.19 = £595 [1]  
 Total Cost = £595 – £205 = £390 [1]  
 £390 ÷ 500 = £0.78 profit on each 2 litre container of milk [1] [4]

8 The design solution should show evidence of the following:

- A Good quality annotated sketches giving consideration to line, shape, form and proportion. [5]
- B It should be a permanent addition to the chair which is aesthetically pleasing. [3]
- C It should identify and justify the choice and size of material(s). [3]
- D It should identify and justify the main manufacturing techniques used in the construction. [4]
- E It should allow the chair to be folded as before. [3]
- F It should include three key dimensions to indicate size and proportion. [2]

**Quality of written communication will be assessed in this question.**

Response Type	Description	Mark Band
When a response is not worthy of credit, [0] should be awarded		
<b>Limited</b>	Student makes an attempt to include some or all of the features listed. Student produces sketches which convey a solution and shows limited ideas. The level of annotation conveys limited information and lacks technical vocabulary and specialist terms. The accuracy of spelling, punctuation and grammar is limited.	[1]–[7]
<b>Satisfactory</b>	Student makes an attempt to include some or all of the features listed. Student produces satisfactory sketches which convey some ideas of the solution. The level of annotation is satisfactory and contains some technical vocabulary and specialist terms. The accuracy of spelling, punctuation and grammar is satisfactory.	[8]–[14]
<b>Very Good</b>	Student makes an attempt to include most or all of the features listed. Student produces very good sketches which clearly convey most or all of the design solution. The level of annotation and technical vocabulary and specialist terms is generally very good. The accuracy of spelling, punctuation and grammar is very good.	[15]–[20]

[20]

**Total**

**AVAILABLE MARKS**

20

**100**