

A LEVEL

Examiners' report

DESIGN AND TECHNOLOGY: PRODUCT DESIGN

H406

For first teaching in 2017

H406/01 Summer 2022 series

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Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers are also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

Advance Information for Summer 2022 assessments

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our [website](#).

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Paper 1 series overview

This component is the first of two examined components and makes up approximately a quarter of the total A Level qualification. This paper is set out through four sets of questions that predominantly cover technical principles within Product Design. Questions require candidates to:

- analyse existing products
- demonstrate applied mathematical skills
- demonstrate their technical knowledge of materials, product functionality, manufacturing processes and techniques
- demonstrate their understanding of wider social, moral, and environmental issues that impact on the design and manufacturing industries.

To do well in this component candidates need to analyse modern consumer products that are designed to meet consumer needs, their design and manufacture, and show understanding of product development and industrial and commercial practices. Candidates are tested on a range of materials and components used in the manufacture of commonly available products, as outlined in the specification.

Candidates need to show clear understanding of topics through extended written responses and support discussions with evaluation and use of examples.

In Mathematical skills questions candidates need to show workings. If an incorrect answer is given but the method is correct, candidates can gain access to some marks.

Many of the questions within the paper are based on consumer products made from multiple materials, candidates are expected to analyse the product and refer to it in context to support their answers.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
<ul style="list-style-type: none"> • related responses to the products or context of the product • showed clear workings in Maths questions • used examples and evaluation to support extended responses • included quality control checks in manufacture/process question and covered the process fully from end to end. 	<ul style="list-style-type: none"> • gave generic answers that did not relate to the product or its context • focused on one or two aspects in extended responses rather than appreciating the complexity of the topic • gave little support with examples in extended responses • focused on one aspect of manufacture in the process question and gave little detail of specific tools, machinery, or quality control.

Question 1 (a) (i) and (ii)

- 1 Toothbrushes are used to clean the teeth and gums of children and adults.

Fig. 1.1 shows two views of a manual toothbrush.

Fig. 1.2 shows two views of an electric toothbrush which has a battery powered oscillating brush.

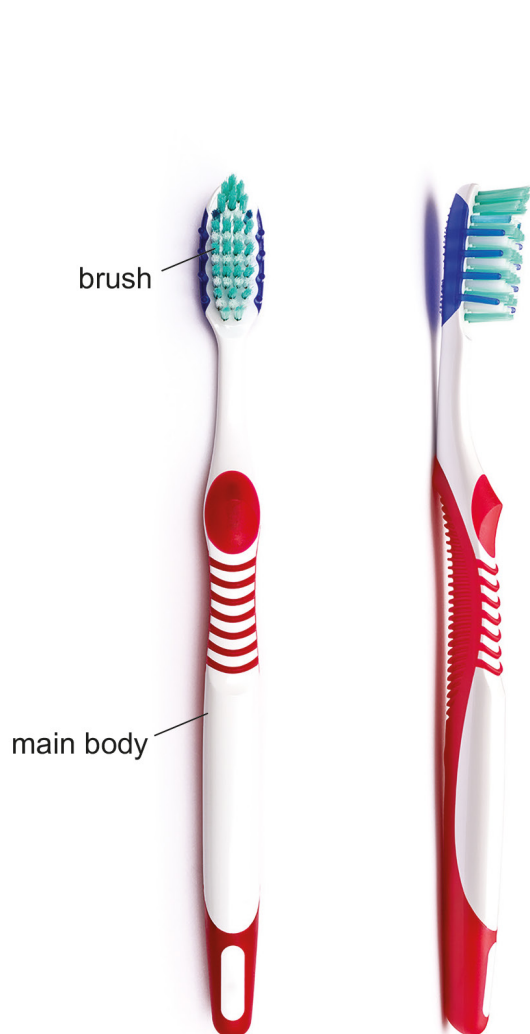


Fig. 1.1



Fig. 1.2

- (a) Both toothbrushes use injection moulding in the manufacture of the handle.
- (i) Identify a suitable specific material for the main body of the manual toothbrush in **Fig. 1.1**.

..... [1]

(ii) Give **two** reasons why the material identified in **part (a)(i)** is suitable.

- 1
- 2

[2]

This question required candidates to analyse two toothbrushes and identify a suitable specific material for the first toothbrush in Fig 1 and then to provide reasons why this material was suitable in the context of a toothbrush.

Exemplar 1

(i) Identify a suitable specific material for the main body of the manual toothbrush in Fig. 1.1.

polypropylene [1]

(ii) Give **two** reasons why the material identified in **part (a)(i)** is suitable.

- 1 The material ~~is~~ has is durable and can support minor accidents with ease like dropping.
- 2 The material is non-toxic, meaning it is safe to go near the or in the user's mouth.

[2]

Exemplar 1 identifies a specific material polypropylene, and then goes on to explain why this material is suitable, i.e. durable in case dropped in everyday use and non-toxic as it will go near the mouth; both points are justified in relation to the use of the toothbrush, so the response gained the full marks available.

Question 1 (a) (iii)

- (iii) Describe how the handle of the electric toothbrush in **Fig. 1.2** would be manufactured to incorporate two different colours of plastic.

.....

.....

.....

..... [2]

A number of candidates accessed both marks indicating that moulding is carried out in two stages or that two separate pieces are moulded and then 'clipped', fused or bonded together.

Question 1 (b) (i) and (ii)

- (b) The electric toothbrush in **Fig. 1.2** is manufactured using a fully automated process.

- (i) Describe what is meant by fully automated manufacture.

.....

.....

.....

..... [2]

- (ii) Justify why this process is suitable.

.....

..... [1]

Question 1(b) parts (i) and (ii) were well answered and it was clear candidates had a good understanding of automated manufacture and its suitability for products such as the toothbrush.

Question 1 (d) (i) and (ii)

- (d) (i) Identify **three** possible environmental issues that could be caused by the design of the toothbrush shown in **Fig. 1.1**.

Justify **each** of your answers.

- 1
-
- 2
-
- 3
-

[6]

- (ii) Explain **three** ways in which the design of the toothbrushes could be developed to further reduce their environmental impact.

Refer to **Fig. 1.1** and/or **Fig. 1.2** in your answer.

- 1
-
- 2
-
- 3
-

[6]

Both parts of Question 1(d) were well answered although some candidates did not justify or explain responses fully and achieved only 1 of the marks for their point.

Question 2 (a)

- 2 Musicians in an orchestra are usually seated to play their instruments. They use a music stand to hold the sheet music.

Fig. 2.1 shows a music stand with an adjustable height. The music holder is made from sheet metal.



Fig. 2.1

- (a) Identify a suitable metal for the music holder.

.....
..... [1]

Question 2 (b)

- (b) Identify a suitable surface finish for the metal you have identified in **part (a)**. Describe the method of application.

.....

.....

.....

..... [2]

This question required candidates to analyse a music stand and identify a suitable metal for the music holder. In part (b) students needed to identify a suitable surface finish and describe the method of application, some candidates did not explain the method of application and focused on the reasons for choosing that process achieving only 1 of the 2 marks available.

Question 2 (c) (i)

The music holder has 45 holes punched through it.

Fig. 2.2 shows an orthographic drawing of the music holder.

Fig. 2.3 shows an isometric drawing of the music holder.

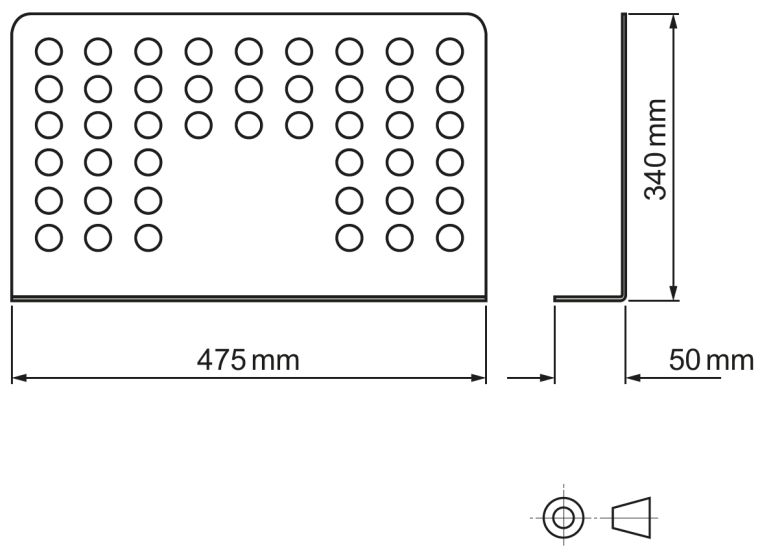


Fig. 2.2
(not to scale)

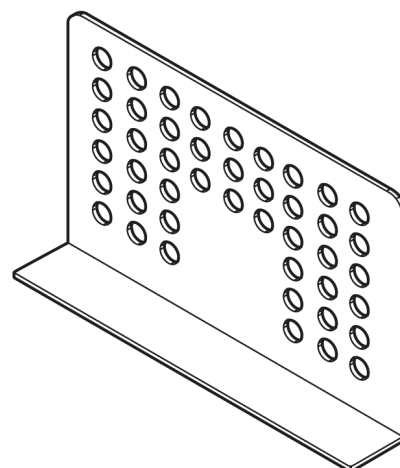


Fig. 2.3

- (c) (i) The diameter of each hole in the music holder is 20 mm.

Calculate the total area of the 45 holes in the music holder. Give your answer in mm^2 and show your working. [3]

Total area of 45 holes mm^2

This was a mathematical question testing simple calculations and many candidates gained full marks. A number of candidates rounded up early but were awarded marks where this could be seen in workings. Candidates who show no workings and present a wrong final answer are awarded zero, it is advisable that all candidates are encouraged to show their workings.

Exemplar 2 clearly shows workings for part 2(c)(i).

Exemplar 2

$$\text{area} = \frac{\pi d^2}{4} \quad \text{Area} = \frac{\pi \times 20^2}{4} = 100\pi \text{ mm}^2$$

$$\text{area of all 45} = 100\pi \times 45 = 14137.17 \text{ mm}^2$$

Total area of 45 holes 14137.17 mm²

Question 2 (c) (ii)

Fig. 2.4 shows part of the music holder.

Fig. 2.5 shows a close up of one of the rounded corners of the music holder.

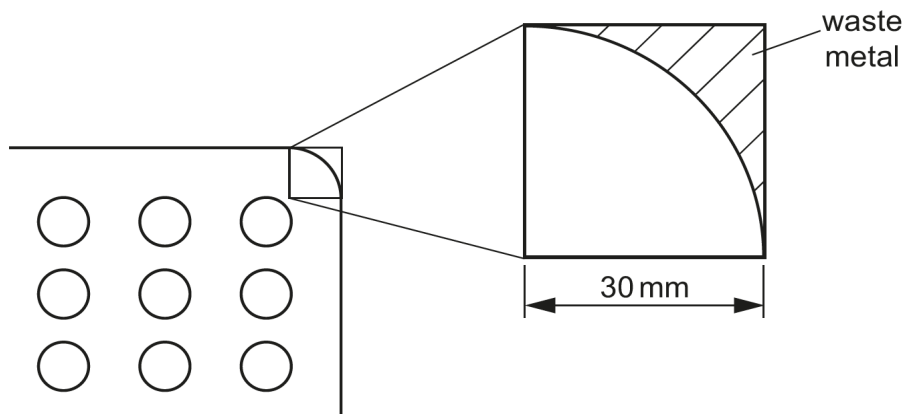


Fig. 2.4

Fig. 2.5
(not to scale)

- (ii) The thickness of the metal used is 1 mm.

Calculate the total amount of waste metal that would be created when shaping the top corners of the music stand. Give your answer in mm^3 to **2** decimal places and show your working.

The formula for calculating the area of a curve = $\pi r^2/4$

[5]

Total amount of waste metal mm^3

This was a mathematical question testing simple calculations and many candidates gained full marks. Where candidates presented an incorrect answer for the previous question and used this in their calculation an ECF (error carried forward) was applied allowing them to achieve marks. Showing workings enables assessors to see the steps taken by candidates and should be encouraged.

Exemplar 3 clearly shows workings for Question 2(c)(ii).

Exemplar 3

$$\text{area of curve} = \frac{\pi r^2}{4} = \frac{\pi \times 30^2}{4} = 225\pi \text{ mm}^2$$

$$\begin{array}{l} \text{area} \\ \text{of} \end{array} = 30 \times 30 = 900 \text{ mm}^2$$

Square

$$\text{waste area} = 900 - 225\pi = 193.14 \text{ mm}^2$$

$$\text{waste volume} = 193.14 \times 1 = 193.14 \text{ mm}^3$$

$$\text{for both corners} = 193.14 \times 2 = 386.28 \text{ mm}^3$$

$$\text{Total amount of waste metal } \underline{386.28} \text{ mm}^3$$

Question 3 (a) (i) and (ii)

3 Designers assess whether a design solution meets its stakeholder requirements.

- (a) (i) State **two** organisations that issue standards that need to be met in the design of products.

1

2 [2]

- (ii) Explain **two** ways in which product designers and manufacturers could test their products to ensure they meet relevant standards.

Make reference to products in your answer.

1

.....

2

..... [4]

Most candidates scored well on the organisations that issue standards to be met in the design of products, the most common were BSi, EC, ISO.

Question 3(a)(ii) about testing products against standards was also answered well by many candidates, candidates talked about possible tests but made no reference to products; some misinterpreting the question talking about why standards are important rather than the ways designers and manufacturers could test products.

Question 3 (b)*

- (b)*** Designers and manufacturers need to determine whether design solutions are commercially viable.

Discuss the value of a feasibility study to determine the commercial viability of a product.

Refer to specific examples in your answer.

.....

.....

.....

.....

.....

..... [8]

There were some good responses to this question, but answers often focused on focus groups and customer feedback. Feasibility studies also involve stock and material availability, the cost to make and technical difficulty of manufacture. To achieve a Level 3 mark, answers needed to cover all aspects of feasibility studies and their value.

Assessment for learning



Feasibility studies are carried out before launching new products, entering a new marketplace, expanding overseas or expanding a product range or scale of manufacture; they involve consideration of:

- the product's impact on user lifestyle
- the product's performance
- technical difficulty of manufacture
- stock and materials availability
- costs and profits: costs of the product and manufacture are compared to the price that the customer is charged.

A feasibility study is part of the NEA assessment criteria and further information can be found in Chapter 8 of the [OCR Design and Technology AS/A Level](#) textbook by Hodder Education.

Question 4

4 **Fig. 4.1** shows a swing seat manufactured from hardwood.

The swing seat has three main parts which include the seat, the frame and the chains. The chains allow the seat to hang and swing.

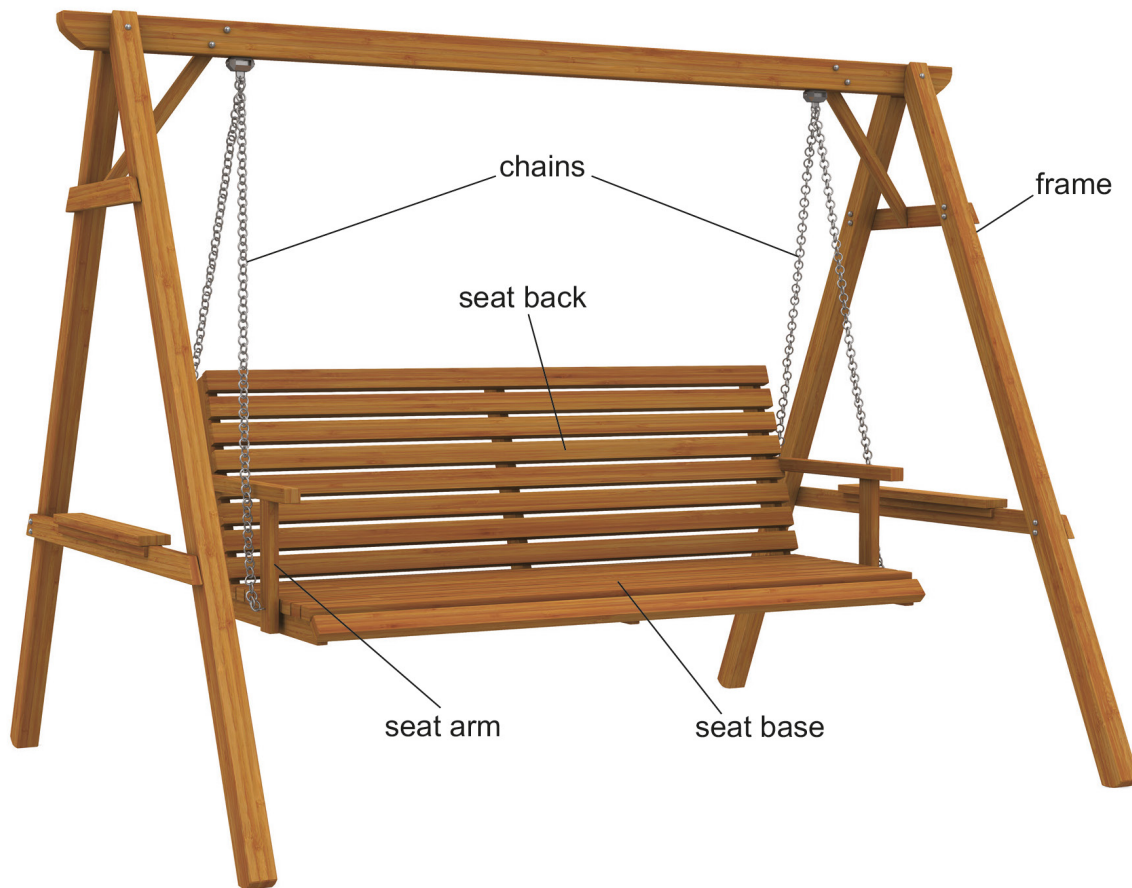


Fig. 4.1

Question 4 (c)

(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:

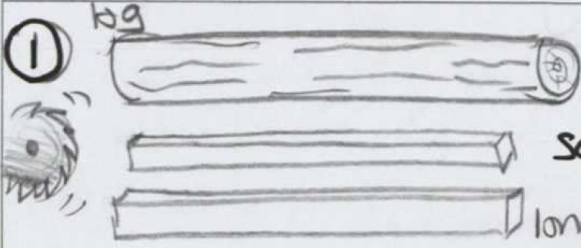
- seat base and back
- seat arms.

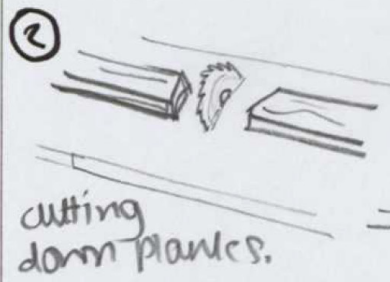
Identify any relevant equipment, machinery and materials.


[8]

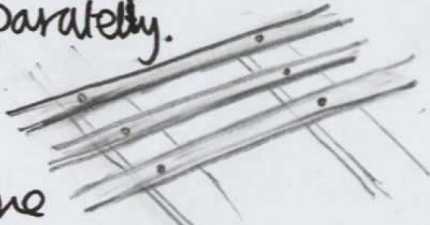
The majority of candidates were able to describe the manufacturing process of making the swing seat. To access the full marks in a Level 3 response, reference to the specific stages, tools and equipment was needed, with details of jigs used and quality control checks

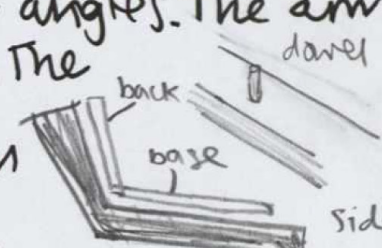
Exemplar 4

①  The logs of wood are cut into set dimensions with a rotary saw or a band saw.
long planks of wood

②  Some of the long planks of wood are cut to smaller bits. This would be for the arms and the back reinforcement.
cutting down planks. side view of arm

③ Once the wood pieces are cut to size they are planed to ensure they are level and even. A spirit level is used to check this. It passes through a go-no-go gauge to ensure it is at the correct thickness. The planks are sanded with a finisher.  planer

④ The planks are now assembled into position. The seat back and seat base are made separately. The planks of wood are drilled into the supports with a pillar drill and screws are drilled in to secure the reinforcements to the plank. The pillar drill only drills a pilot hole. 

⑤ The arms are placed together. A set square is used to ensure they are at right angles. The arms are ~~also~~ secured with a dowel joint. The dowels are pushed in with a mallet.  dowel back base side view jig

⑥ The back and base are placed in an angled jig to ensure the angle is accurate. They are bolted together.

⑦ The arms are added and bolted to the swing. Brackets are added for reinforcement.

⑧ Holes are drilled so the chain can be attached.

⑨ The swing is finished with an oil ~~new~~ coating. ~~under a~~

In the response in Exemplar 4 there is some consideration of the jigs used and QC checks meaning the candidate is able to access the Level 3 marks. Candidates should be encouraged to extend responses beyond a basic textbook response and relate to the specific product. There was no requirement to explain the material source but the detail of pilot holes, specific machinery and use of jigs and regular checks make for a strong example that is supported by clear sketches of manufacturing steps covering marking out, cutting or drilling, assembly and finishing.

Question 4 (e)

- (e) Discuss the sustainability issues that would need to be considered in the design and manufacture of the swing seat.

Refer to specific examples from the swing seat in your answer.

.....

.....

.....

.....

.....

..... [6]

This level question was answered well. The full range of issues was often covered from the sourcing of raw materials, repair, and disassembly, reducing materials and parts and manufacturing methods and transportation.

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