

**A LEVEL**

**Examiners' report**

# **DESIGN AND TECHNOLOGY: PRODUCT DESIGN**

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**H406**

For first teaching in 2017

**H406/02 Summer 2023 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 is 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.

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## Paper 2 series overview

This is the third full series for this A Level for H406/02, Problem Solving in Product Design. The candidates appeared to have had a good grounding across this component.

The report below seeks to give pragmatic advice to centres that will be helpful as they prepare their next cohort for this style of examination.

### Basic concept

This style of examination has an allowed time of 1 hour 45 minutes.

The examination has a Resource Booklet that is inherently linked to the detail of the examination paper and questions therein.

The recommended reading time for the Resource Booklet is 35 minutes, although it does appear that candidates have spent less time on the booklet to allow more time working on the actual paper. Candidates appear to work through the Resource Booklet in unison with the examination paper, as they work through both documents chronologically.

The total mark for this paper is 70.

The marks for each question are shown in brackets [ ].

Quality of extended responses will be assessed in the questions marked with an asterisk (\*).

Candidates often used sub-headings to communicate effectively on extended responses as well as manufacture/assembly style questions, this is a good tactic and appears to help candidates to order and communicate their thoughts both logically and clearly.

Candidates also used sub-headings when questions had scaffolding that asked for responses to include specific bullet points, this was an extremely useful strategy for them to use.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
<ul style="list-style-type: none"> <li>used the scaffolding bullet points within questions to frame their responses</li> <li>used sub-headings to good effect to aid communication</li> <li>had a full grasp of the specification and were able to apply their knowledge to an unfamiliar situation</li> <li>used the Resource Booklet to exemplify their responses.</li> </ul>	<ul style="list-style-type: none"> <li>did not always use the scaffolding bullet points fully to support their responses</li> <li>fixated on one aspect of a question only</li> <li>found communicating their responses challenging, where sketching could have been helpful.</li> </ul>

## Question 1\*

- 1\* A large accountancy firm, OCR Accountants, is assessing the feasibility of providing home office equipment to its employees.

As part of this assessment, it wishes to understand the challenges that are experienced by employees when working at home.

Critically examine the problems experienced by employees when working at home.

In your answer you **must** consider the following:

- ergonomics
- musculoskeletal issues
- location.

Refer to information on **page 2** of the Resource Booklet.

**[12]**

Questions 1, 3 and 5 within this exam paper were all of a 'critically examine' style.

Most candidates answered this question very well.

Critically examining the feasibility and challenges of providing home office equipment to facilitate working at home clearly appealed to candidates, who were familiar with the expectation of the question.

Candidates mostly used the scaffolding bullet points very well, utilising them as part of both the planning and delivery of their responses. They had a good understanding of the impact in relation to ergonomics, musculoskeletal issues, and location.

Most candidates used the Resource Booklet effectively, taking the relevant information out of it and presenting it in a way that highlights the problems faced. The best responses were able to use the Resource Booklet to support, justify and exemplify their responses and not just copy out sections.

Level 4 responses gave a comprehensive examination of the problems experienced by employees when working at home.

Care should be taken with an extended response question that the candidate examines the challenges and does not simply produce a list of the issues. The extended response question is there for the candidate to demonstrate their ability to articulate the challenges faced by the given stakeholders.

Some less successful candidates did become fixated on one point and focused their response on this, for example only discussing ergonomics.

## Question 2 (i)

- 2 To ensure the combination of the ergonomic chair and standing desk shown in **Fig. 4** is suitable for OCR Accountants, a designer has been tasked with checking the product specifications against anthropometric data.

Use the anthropometric data in **Fig. 3A** and **Fig. 3B** to help you answer the following questions.

- (i) Complete the table to indicate the **total height range** for **90%** of the population: **[1]**

	Total height range (mm)
Sitting height	
Sitting eye height	
Sitting shoulder height	

Dimensions in mm	Total height range mm:
Sitting height	800 - 970
Sitting eye height	700 - 860
Sitting shoulder height	530 - 660

Or

Dimensions in mm	Total height range mm:
Sitting height	170
Sitting eye height	160
Sitting shoulder height	130

Candidates were for the most part able to extract the total height range from the anthropometric data provided as in the first table above or indeed simply work out the range between the 95% Men and 5% Women percentiles.

## Question 2 (ii)

- (ii) Calculate the **mean thigh thickness** of the population if there are equal numbers of men and women. Give your answer in mm and show your working. [2]

Mean thigh thickness ..... mm

Mean thigh thickness

$$= \frac{(155+150)}{2} =$$

$$= \frac{305}{2} = \mathbf{152.5mm}$$

Or

$$= \frac{(130+155+180+120+150+180)}{6}$$

$$= \frac{915}{6} = \mathbf{152.5mm}$$

Candidates found this question very much to their liking and were able to calculate the mean thigh thickness in one or other of the two methods detailed above.

## Question 2 (iii)

- (iii) Calculate the **maximum distance** the desk **must** rise to maintain a comfortable elbow height position for 90% of the user population. Give your answer in mm and show your working. [3]

Maximum distance ..... mm

Minimum elbow to floor distance = 5%ile female sitting elbow height + 5%ile female popliteal height  
= 190 + 370 = **560mm**

Identify maximum standing elbow height = 95th%ile male standing elbow height = **1180mm**

Maximum rising distance = **1180 – 560 = 620mm**

Candidates found this part of the question the most challenging, with the minimum elbow to floor distance often being misinterpreted and only the sitting elbow height being considered, when the popliteal height was also required.

Most candidates did, however, identify the maximum standing elbow height.



## Question 3

**3** Smart Space has recommended a standing desk product called Stand-Hi to OCR Accountants.

Critically examine the design requirements that would have been considered when designing the standing desk shown in **Fig. 5** of the Resource Booklet.

In your answer you **must** consider the following needs and requirements of employees working at home:

- aesthetics
- functionality
- anthropometrics.

Refer to information on **pages 3–5** of the Resource Booklet.

**[12]**

Questions 1, 3 and 5 within this exam paper were all of a 'critically examine' style.

Most candidates answered this question very well.

Critically examining the design requirements that would have been considered when designing the standing desk clearly appealed to candidates, who were familiar with the expectation of the question.

Candidates used the scaffolding bullet points very well, utilising them as part of both the planning and delivery of their responses. They had a very good understanding of the needs and requirements of aesthetics, functionality, and anthropometrics. Candidates often linked a given aspect of the standing desk into more than one of the scaffolding bullet points; the cable tidy was often used to support aesthetics and functionality as it helps retain the sleek modern look, avoid clutter, and make sure the working environment is safe.

Most candidates used the Resource Booklet effectively, taking the relevant information out of it and presenting it to support, justify and exemplify their responses and did not just copy out sections.

Level 4 responses gave a comprehensive examination of the needs and requirements of employees working at home.

Some less successful candidates did become fixated on one point and focused their response on this, for example only discussing ergonomics.

## Question 4

4 OCR Accountants requires an initial quantity of 100 standing desks.

You **must** focus only on the following features of the concept design:

- laminate desktop with your choice of surface finish from the options given
- mild steel frame.

Use sketches and/or notes to outline suitable methods of manufacture and assembly for the features of the standing desk concept design as shown in **Fig. 5** of the Resource Booklet.

In your answer you **must** include details of:

- manufacturing processes
- standard components to be used
- finishes
- assembly methods.

**[16]**

Candidates often used the bullet points from the question to underpin their responses and we regularly saw all four of them covered to a greater or lesser extent.

Manufacturing processes have clearly been covered by many centres, with numerous sensible suggestions communicated. CAD/CAM, CNC routing, veneering, laser cutting, plasma cutting and presswork that included stamping and folding were all used to good effect with extrusion also included on a regular basis. Tessellating components was also popular when press work was being offered as a route to manufacture.

Standard components, standardised parts, stock form and bought in items were also well communicated with assembly methods utilising nuts and bolts, screws and threaded inserts. Stock forms of manufactured boards, sheet steel and tube were also clearly understood by many candidates.

Assembly methods ranged a little, but welding was used correctly in a number of cases and to good effect. Finishes also brought a variety of responses but often both the mild steel frame and laminate desk top were well communicated with powder coating being clearly understood.

Level 4 responses had a comprehensive demonstration of all of the four required areas within the question.

Some less successful candidates did not use the structure of the question to support their response and as such either did not include details on the two parts of the standing desk or missed out on the details outlined in the bullet point list that were asked to be included in their response.

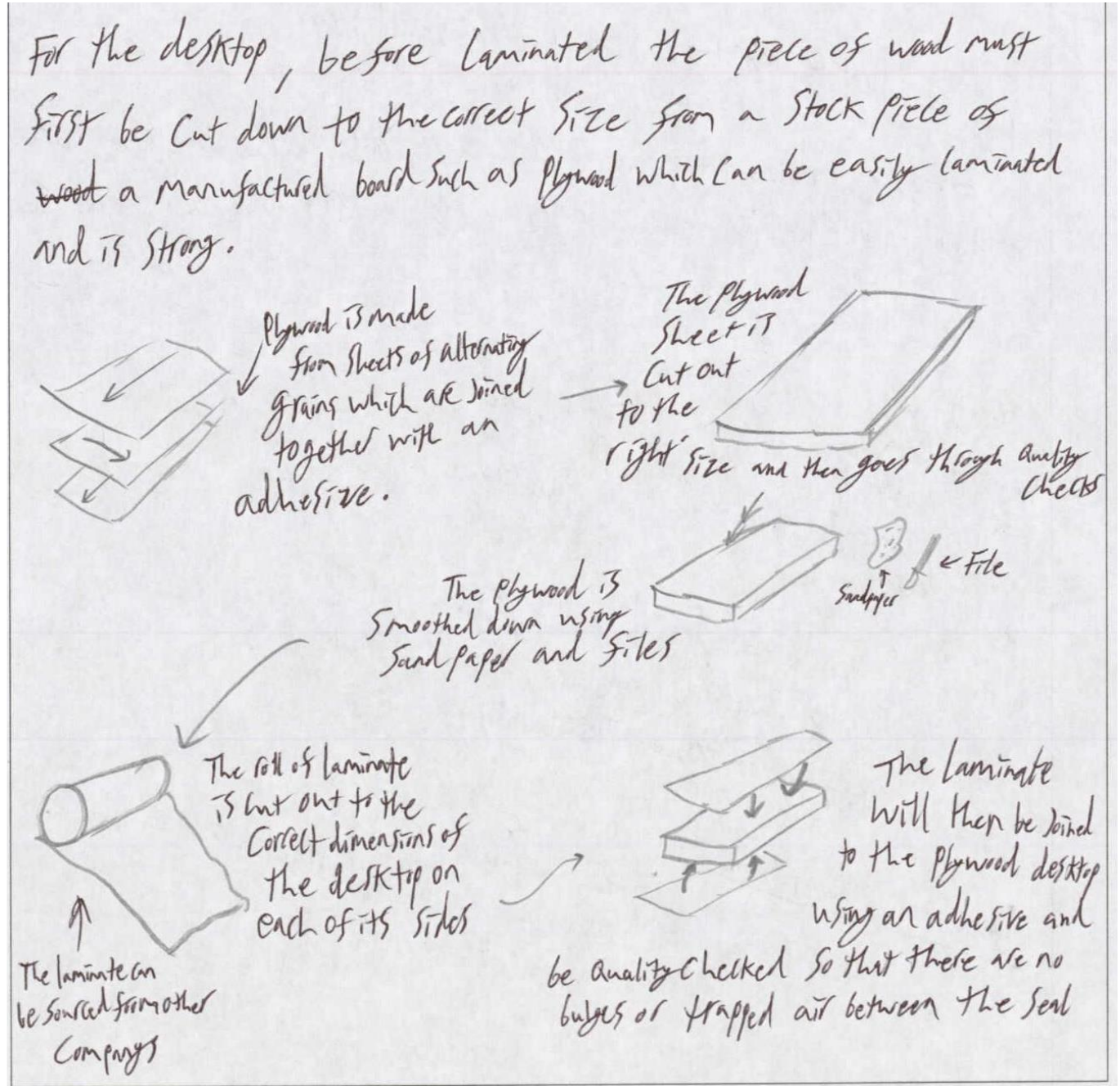
Some candidates also included parts of the standing desk that were not required within the question, with the polypropylene cable tidy often included.

Supporting sketches were often lacking in detail.

### Specification coverage

Sketching skills, whether in two or three dimensions did not always fully support the level of communication candidates really needed for Question 4 and Question 6. This is another skill that can be approached across the endorsement and will benefit them within their NEA and examinations.

## Exemplar 1






The desk frame is manufactured from mild steel, the frame is made up of ~~4~~ <sup>3</sup> pieces, the legs and the 3 parts, the legs, the feet and the main bracket that joins to the desktop.

### Desk's feet



The feet are a thin trapezium shaped piece of metal which support and stabilize the desk.

They will first be bought as stock pieces of mild steel,  x2

To be cut down into the correct shape and with the same angle on either side they'll be cut down using a Jig and a Circular Saw,

The Jig will be made from a piece of wood and will indicate the angle at which it must be cut



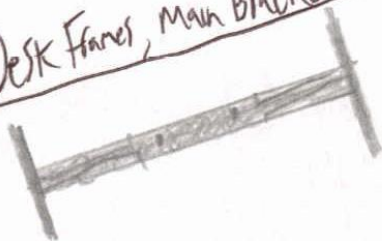
The same piece can be used for either side



With these feet cut out they will be quality checked and finished with a powder coating to ensure its durability



### Desk Frame, main Bracket:

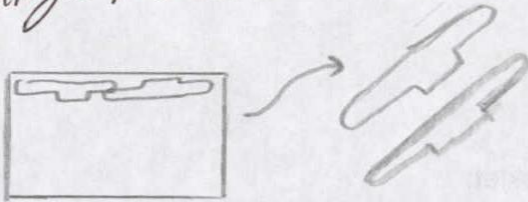


The main frame will also be initially purchased as a stock form of metal:

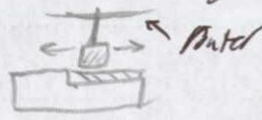


9

The two end pieces which are perpendicular to <sup>the</sup> central part of the main frame will be cut out from a piece of sheet metal using a laser cutter being sure to waste as little material as possible through tessellation

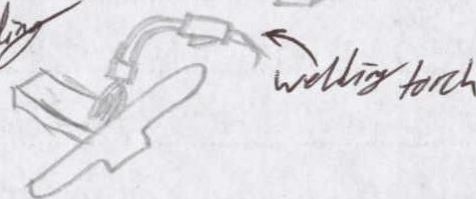


Next for the main part of the bucket it will be cut down to the correct shape with the right details using a router,



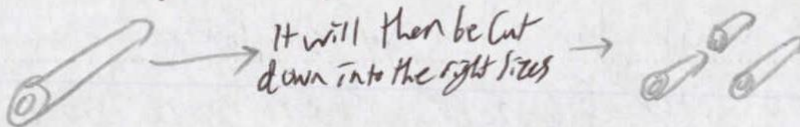
stock piece

With the pieces now complete they will be smoothed down joined together through MIG welding and then powder coated,



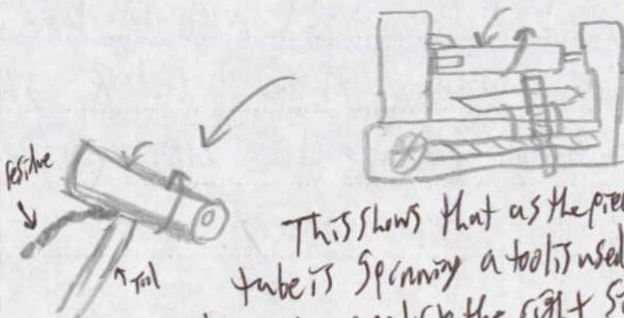
## Desks Legs:

The legs are made up of many cylindrical mild steel components which allow for the desk to rise and fall, each of these cylinders can be first bought as a stock piece of tubing



It will then be cut down into the right sizes

In order for the diameters of the cylinders to be changed they will be used a metal lathe



This shows that as the piece of tube is spinning a tool is used to cut down the cylinder to the right size and then powder coated

With the cylinders all cut out they will

With the frame now all complete each of the components will be joined together through welding of rivets.



Exemplar 1 shows a response with comprehensive understanding of the **four aspects** specified in question in relation to **both** the desktop and frame. Information in the Resource Booklet is used effectively to fully exemplify the points being made. The sketches are clear and supported with relevant notes.

## Question 5\*

**5\*** Hot-desking has become a popular trend in many modern office spaces.

Critically examine the challenges that would be faced by OCR Accountants in providing an effective open plan office with hot-desks for employees.

In your answer you **must** consider the following:

- inclusivity
- privacy
- storage of personal belongings
- digital technology.

Refer to information on **page 6** of the Resource Booklet.

**[12]**

Questions 1, 3 and 5 within this exam paper were all of a 'critically examine' style.

Candidates answered this question reasonably well.

Critically examining the challenges that would be faced in providing an effective open plan office with hot desks for employees, was a situation that candidates understood, if they had a full grasp of the four scaffolding bullet points.

Candidates mostly used the scaffolding bullet points, utilising them as part of both the planning and delivery of their responses. They had a very good understanding of the challenges that would be faced by OCR Accountants in terms of the impacts related to privacy, storage of personal belongings and digital technology often suggesting sensible and logical work arounds to improve the situation for the employees. However, a large proportion of candidates did not have a full grasp of inclusivity and either misinterpreted the term or indeed did not offer an answer to this aspect of the question. Please see the note on specification coverage in the blue box below.

Most candidates used the Resource Booklet effectively, taking the relevant information out of it and presenting it to support, justify and exemplify their responses and not just copy out sections.

Level 4 responses gave a comprehensive examination of the needs and requirements of employees working at home.

Care should be taken with an extended response question that the candidate examines the challenges and does not simply produce a list of the issues. The extended response question is there for the candidate to demonstrate their ability to articulate the challenges faced by the given stakeholders.

Some less successful candidates did become fixated on one or two points and focused their response on these, for example only discussing privacy and the storage of personal belongings.

## Specification coverage

Centres are urged to cover all areas that appear in the specification for this endorsement. It was clear that some candidates did not have the necessary knowledge of inclusivity.

## Question 6

- 6 The design team has developed a concept design called Easy-Stand for a standing desk converter.

In order to reduce weight, a prototype polymer laptop shelf has been designed and made to support the laptop.

Smart Space requires an initial quantity of 100 polymer laptop shelves for consumer testing.

Use sketches and/or notes to outline suitable methods to meet the following design and manufacturing requirements for the **polymer laptop shelf only**:

- include a non-slip texture to the shelf top surface
- provide structural reinforcement
- batch manufacture 100 polymer laptop shelves
- take account of design for manufacture (DFM).

Refer to information on **pages 7–8** of the Resource Booklet.

**[12]**

Where candidates had allowed enough time, then this question seemed to appeal.

Candidates often used the scaffolding bullet points to underpin their responses.

Those candidates that responded correctly did so with lots of detail. Level 4 responses had a comprehensive demonstration of a relevant batch manufacturing process with injection moulding or 3D printing being regularly and correctly detailed with both sketches and notes.

It was gratifying that a significant number of candidates linked the opportunity to manufacture the detail required to include both a non-slip surface and structural reinforcement within the mould tool design for injection moulding or indeed via CAD and 3D printing, therefore retaining a one-piece product, which then also gave supplementary support to the requirements of design for manufacture.

The addition of a laser cut material that could be added to the surface of the shelf to increase friction and often tessellated was also popular with candidates.

Some less successful candidates did not use the structure of the question to support their response and as such missed out on the details outlined in the bullet point list that were asked to be included in their response.

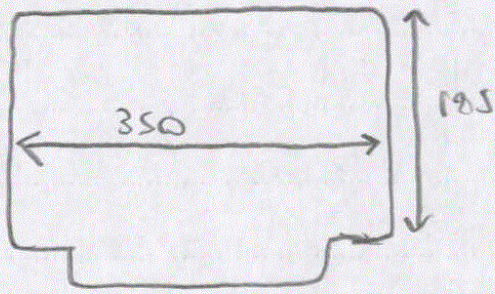
Design for manufacture (DFM) did prove particularly challenging for a significant number of candidates, with this requirement often being misinterpreted or missed out entirely.

Some candidates gave answers that sought to manufacture the birch plywood Easy-Stand standing desk converter rather than the polymer laptop shelf that was required and highlighted within the question.

Supporting sketches were occasionally lacking in detail.



## Exemplar 2

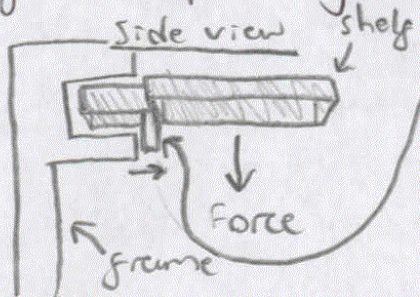


The dimensions of the shelf must ~~also~~ provide enough space to cater for 90% of laptop sizes. Data for the 5<sup>th</sup> and 95<sup>th</sup> percentiles of laptop sizes

will be used for this. It must be ~~over~~ up to 15" in width.

### Design:

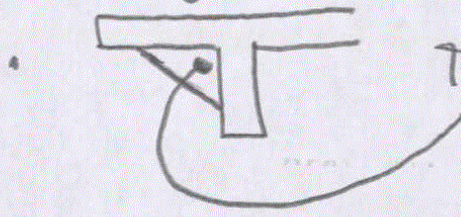
- CAD can be used to generate 3D images of the design.
- Specialist CAD programmer should be used to test the stress the shelf can withstand at the pivot via stress analysis. This means the right material, thickness and density can be used to ensure the shelf can bare a load of ~~5kg or more~~ approximately 5kg, allowing for laptops of multiple weights to be mounted on it.



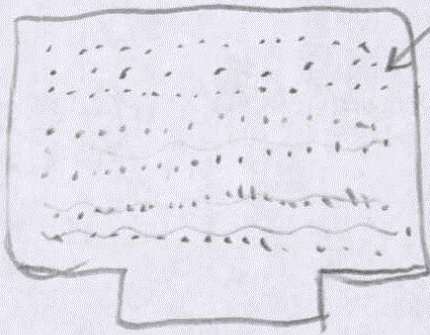
This thin vertical piece would undergo the most normal contact force, as it is where the shelf will be hooked. Computer stress analysis will identify \* x



\* the right shape so that it can endure this perpendicular force.

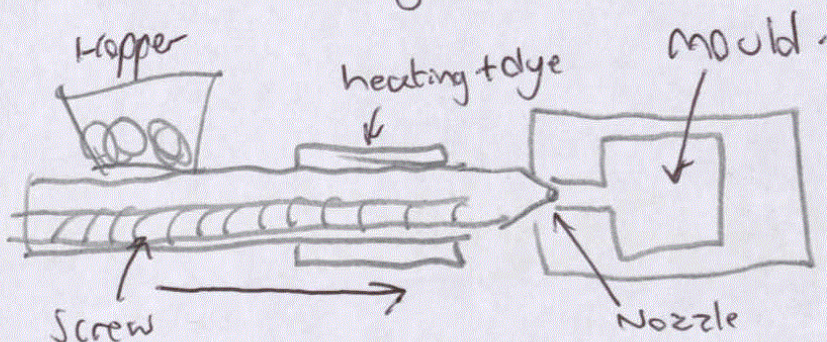


Triangulation could be used to increase the force it can withstand to meet requirements.



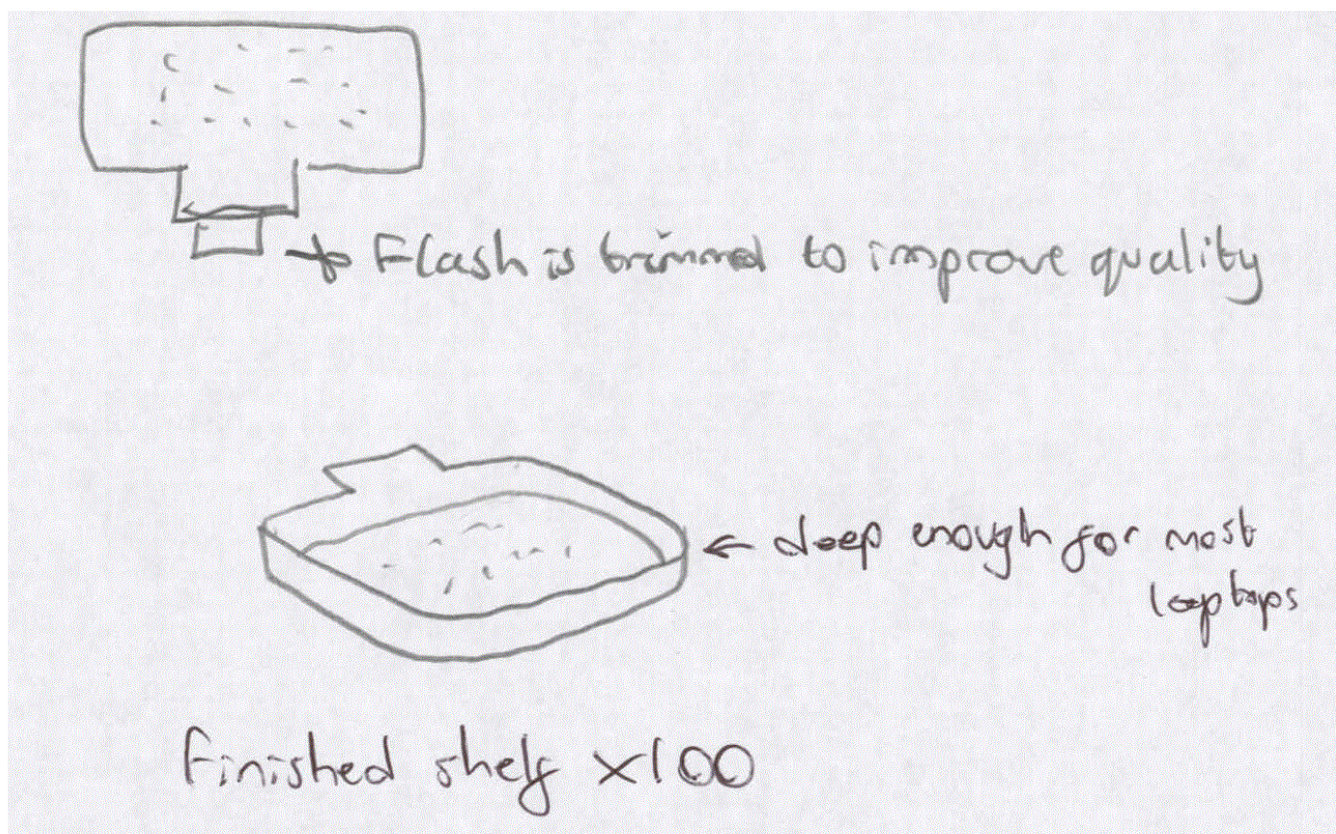
The surface on which the laptop rests would have a dotted texture to prevent slippage.

- ABS would be used as it is rigid, tough and won't fracture under stress. It is also a thermoplastic so can be moulded.
- ~~The ABS would be moulded via injection~~
- The shelf would be produced via injection moulded ABS.
- Injection moulding ensures that the detail of the textured surface can be produced.



- The ABS pellets are melted in the hopper, and pushed through the nozzle via the helix effect at high pressures to mould the plastic. The plastic is cooled and released from the mould via ejector pins.
- The use of a single polymer (ABS) allows for faster, and easier and simpler manufacturing. <sup>DFMA</sup>





Exemplar 2 shows a response with comprehensive understanding of the **four aspects** specified in question in relation to **both** the desktop and frame. Information in the Resource Booklet is used effectively to fully exemplify the points being made. The sketches are clear and supported with relevant notes.

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