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## DESIGN & TECHNOLOGY

0445/31

Paper 3 Resistant Materials

May/June 2024

1 hour

You must answer on the question paper.

No additional materials are needed.

### INSTRUCTIONS

- Section A: answer **all** questions.
- Section B: answer **one** question.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Answer in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

### INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [ ].
- All dimensions are in millimetres unless otherwise stated.

This document has **20** pages.

## Section A

Answer **all** questions in this section.

- 1 Fig. 1.1 shows a tennis racket made from carbon fibre reinforced plastic (CFRP).

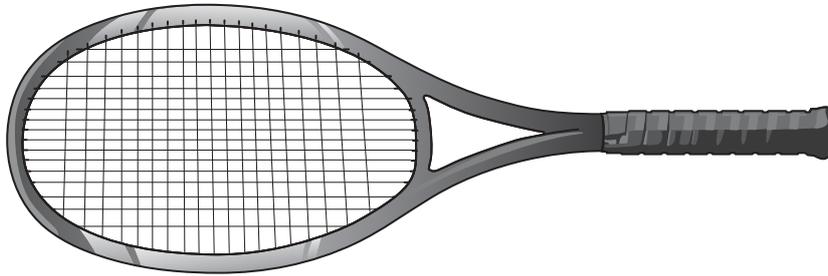


Fig. 1.1

State **two** properties of carbon fibre reinforced plastic (CFRP) that make it suitable for the tennis racket.

- 1 .....
- 2 .....
- [2]

- 2 Table 2.1 shows three types of drill bit.

Table 2.1

Types of drill bit	Chosen number
	
	
	

Complete Table 2.1 by adding the number from the list below to show the correct use for each drill bit.

- 1 used to drill smooth sided, flat bottomed holes
- 2 used in a centre lathe to start off a hole in metal
- 3 used for countersinking holes in wood and metal
- 4 used for fast drilling in wood
- 5 used to drill 20–75 mm diameter holes

[3]

- 3 Fig. 3.1 shows the outline shape and a development (net) for a tray made from 1.5 mm mild steel sheet.

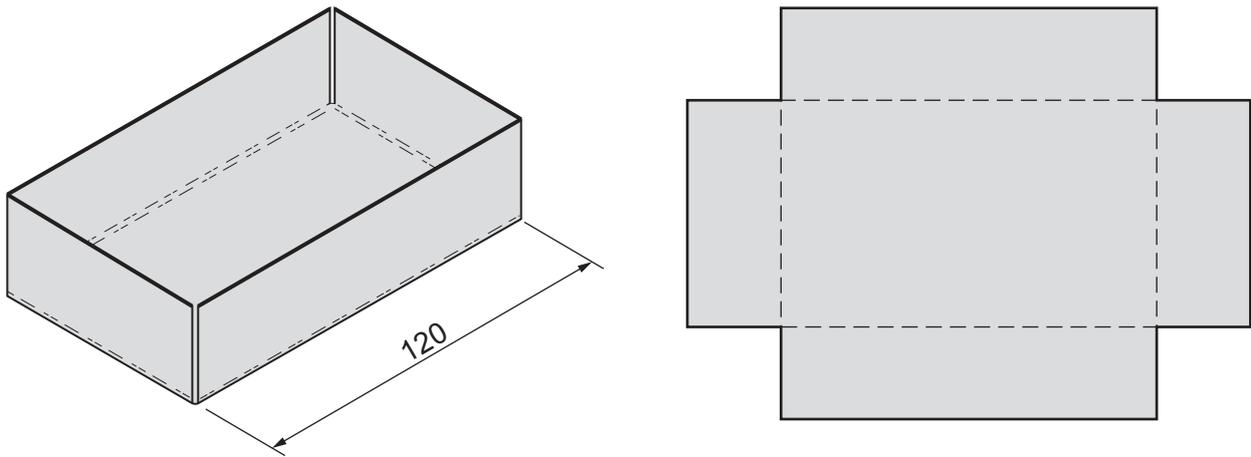


Fig. 3.1

- (a) Add flaps to the development (net) shown in Fig. 3.1 that would enable the sides of the tray to be joined correctly when bent to shape. [2]

- (b) The tray must have safe edges.  
Explain what is meant by the term 'safe edge' when working with sheet metal.

.....

.....

..... [2]

- 4 Fig. 4.1 shows two parts, **A** and **B**, of an incomplete housing joint.

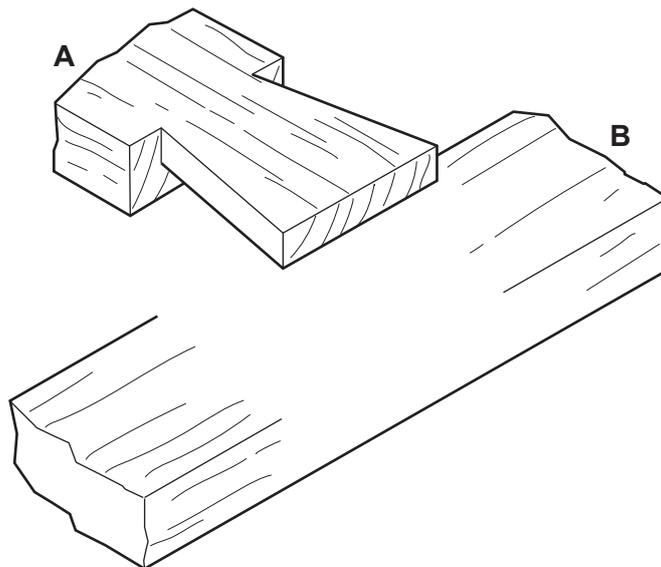
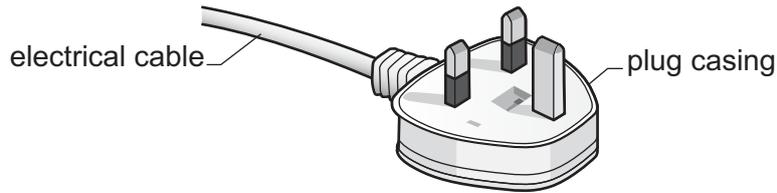


Fig. 4.1

- Draw on part **B** in Fig. 4.1 to show the other part of the housing joint. [3]

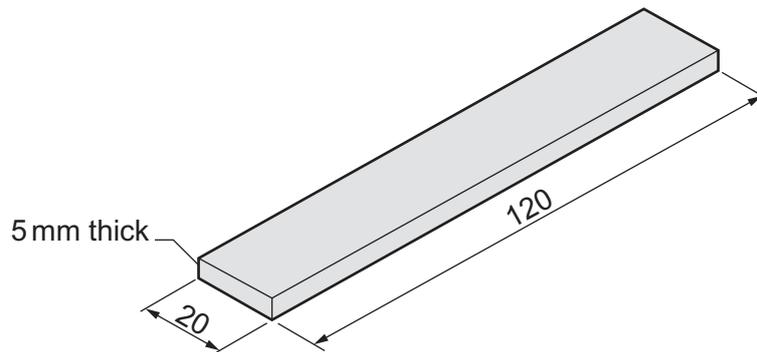
5 Fig. 5.1 shows an electrical plug with a length of electrical cable covered with plastic.



**Fig. 5.1**

- (a) Name a specific thermoplastic that could be used to cover the electrical cable.  
 ..... [1]
- (b) Name a specific thermosetting plastic that could be used for the plug casing.  
 ..... [1]
- (c) State **one** property of plastic that makes it suitable for electrical fittings.  
 ..... [1]

6 Fig. 6.1 shows a length of brass that is to be heated to a dull red colour.



**Fig. 6.1**

Complete the following sentences.

- (a) The process of heating the brass to a dull red colour and leaving it to cool is known as  
 ..... [1]
- (b) The process makes the metal ..... so that it becomes easier to work. [1]

7 Fig. 7.1 shows a paint pot holder made of wood.

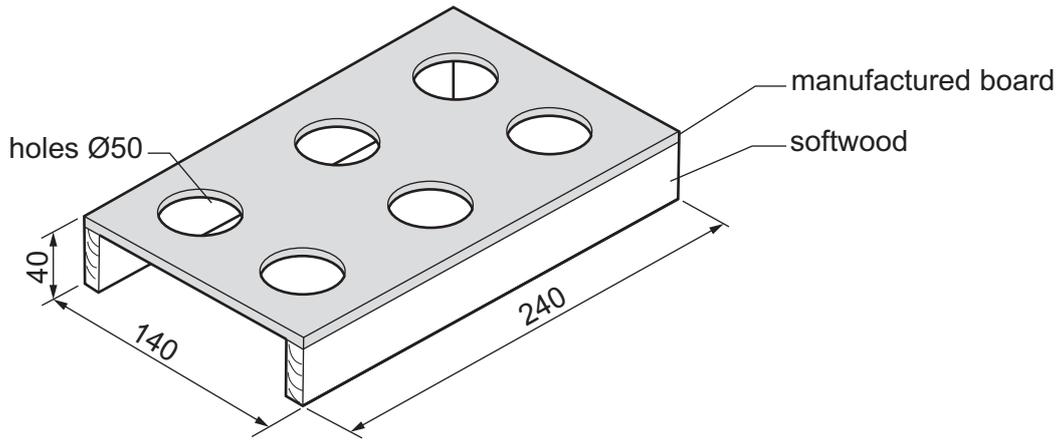


Fig. 7.1

Use sketches and notes to show how the paint pot holder could be redesigned and made from **one** sheet of thermoplastic measuring 240 × 220. Do **not** include details of the holes.

[3]

8 Table 8.1 gives detailed stages of a process that could be carried out on steel.

Table 8.1

Stage	Process
1	Heat up steel to dull red
2	Dip steel into carbon powder
3	Repeat stages 1 and 2 three times
4	Reheat steel to dull red
5	Quench in water

Name the process detailed in Table 8.1

..... [1]

- 9 Fig. 9.1 shows views of a small box made of hardwood. The hardwood base has been glued and screwed to the sides of the box.

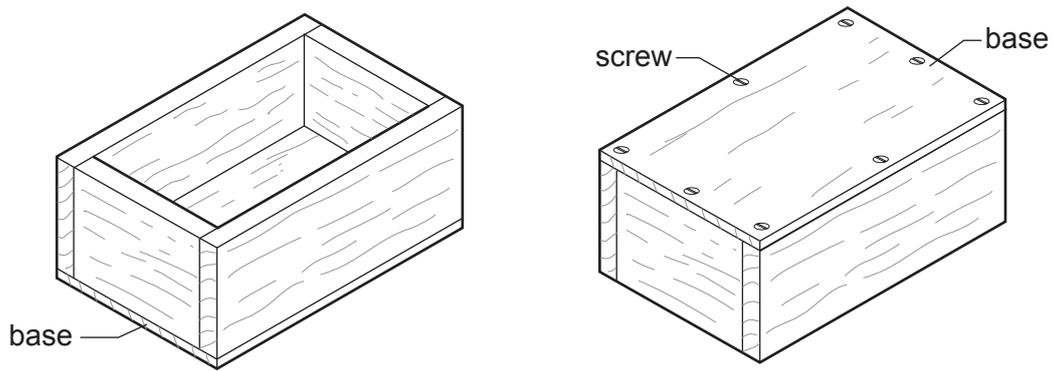


Fig. 9.1

Explain what is likely to happen to the base of the box, over time, as a result of gluing and screwing it to the sides of the box.

.....

.....

..... [2]

- 10 Fig. 10.1 shows a variety of food containers made of plastic and manufactured by the vacuum forming process. One benefit of using this process is that the containers can be produced quickly.



Fig. 10.1

Give **two** other benefits of using the vacuum forming process to manufacture the food containers.

1 .....

2 .....

[2]

## Section B

Answer **one** question from this section.

- 11 Fig. 11.1 shows views of an incomplete design for a teaching aid that could be used to teach children addition and subtraction. The case is made from MDF and the feet are made from aluminium.

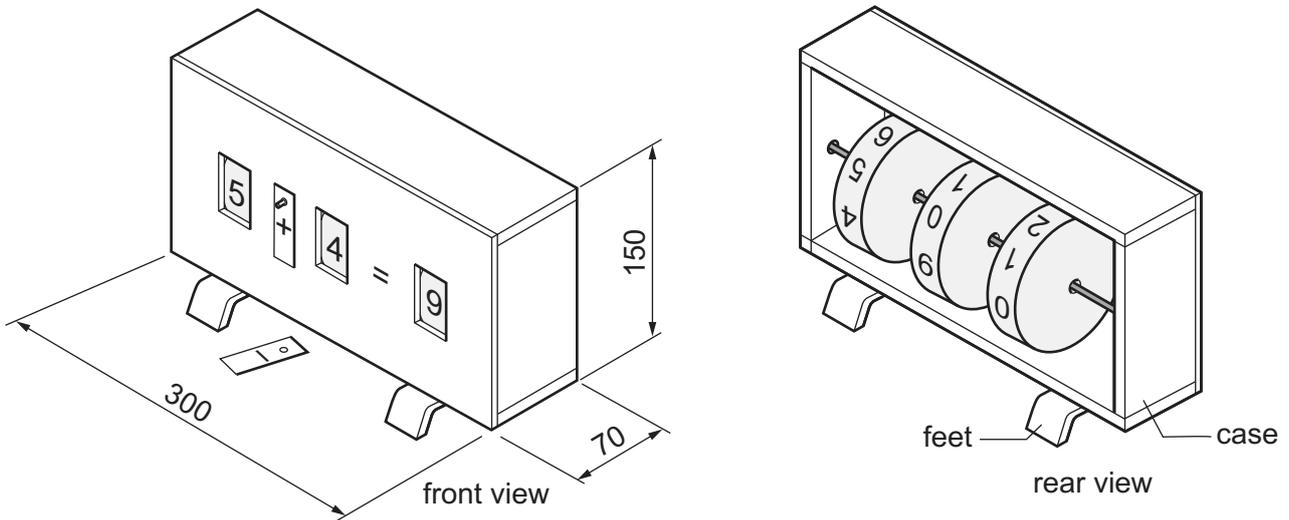


Fig. 11.1

- (a) Fig. 11.2 shows the front of the case with the windows marked out, ready to be cut out. Use sketches and notes to show how **one** window could be cut out by hand. Name all the tools and equipment used.

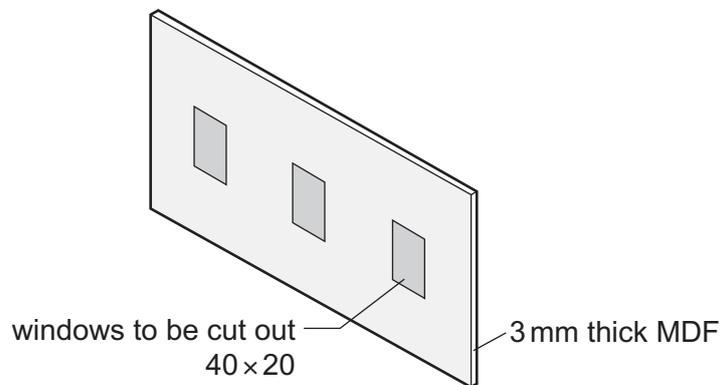
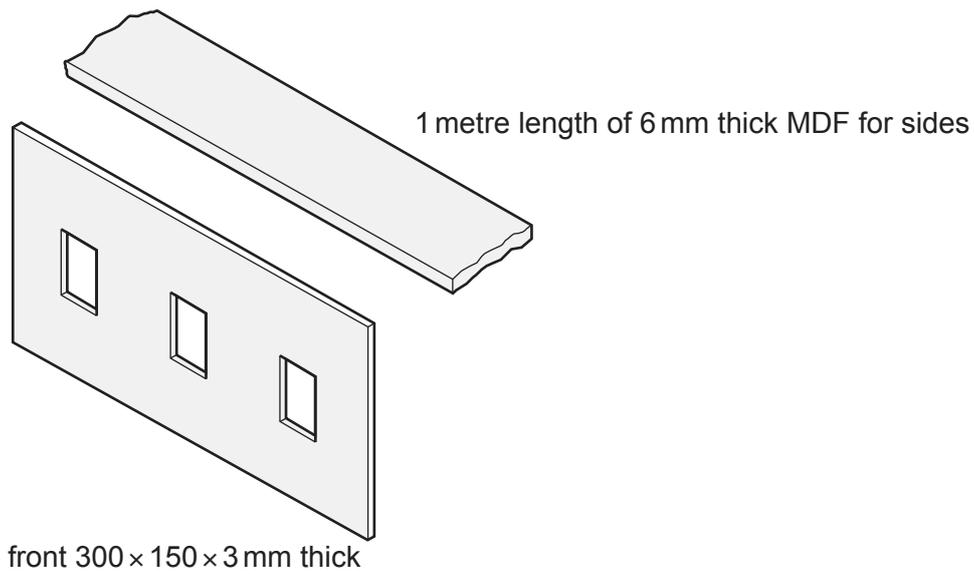


Fig. 11.2

(b) Fig. 11.3 shows the front of the case and part of a length of MDF from which the four sides of the case are made.



**Fig. 11.3**

Complete Table 11.1 by giving four additional stages required to make the case.

**Table 11.1**

Stage	Process
1	<i>Mark out the sides to the required lengths</i>
2	
3	
4	
5	

[4]

(c) The case could be made from one piece of sheet material without the use of any joints. Name a suitable material and describe how the case could be produced.

.....

.....

.....

.....

..... [4]

- (d) Fig. 11.4 shows details of one of the discs made from MDF with the numbers 0–9 on the edge of the disc.

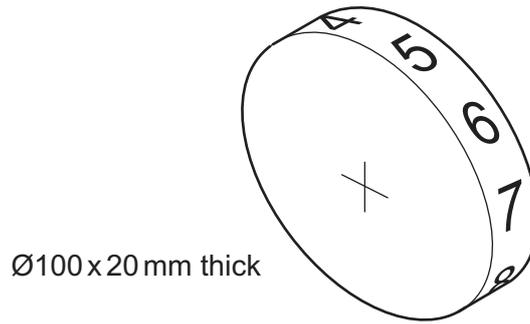


Fig. 11.4

- (i) Use sketches and notes to show how **one** disc could be produced using workshop tools and equipment.

[3]

- (ii) Describe how the numbers 0–9 could be produced and applied to the edge of the disc using CAD/CAM.

.....

.....

.....

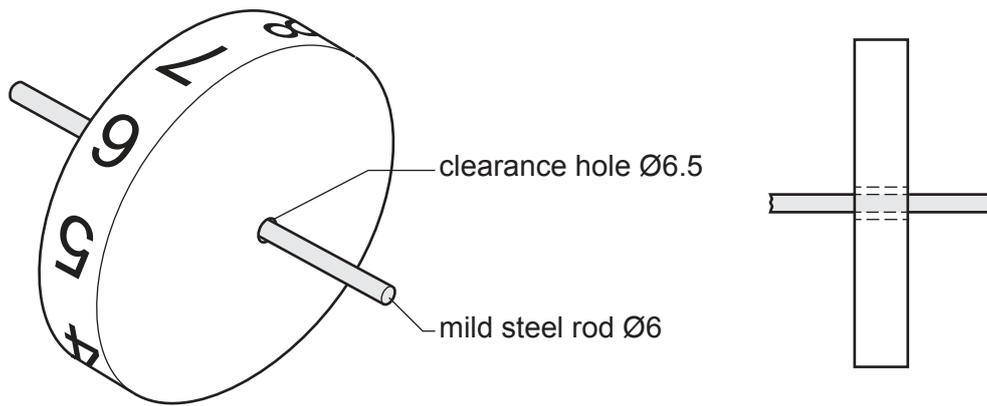
.....

.....

.....

..... [4]

- (e) Fig. 11.5 shows details of the discs and the mild steel rod on which the discs rotate. The discs must be prevented from sliding along the mild steel rod.



**Fig. 11.5**

Use sketches and notes to show how the discs could rotate freely and be prevented from sliding along the mild steel rod.  
Give details of all materials and constructions used.

[3]

- (f) Fig. 11.6 shows details of one of the feet made from aluminium. Use sketches and notes to show how **one** foot could be produced from a length of aluminium  $150 \times 25 \times 2$  mm thick.

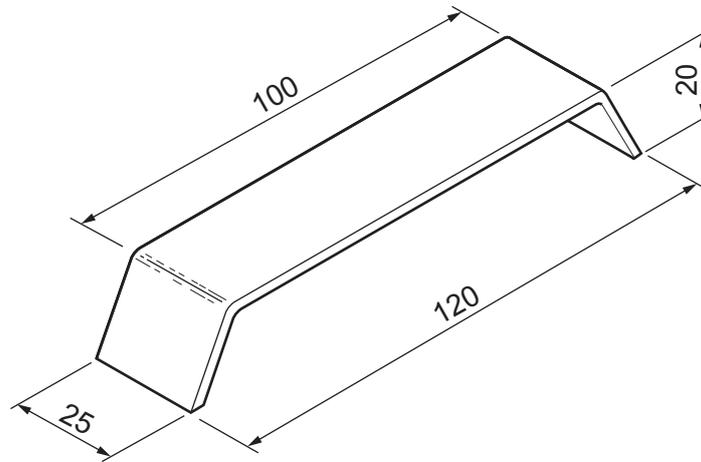
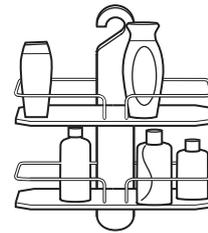
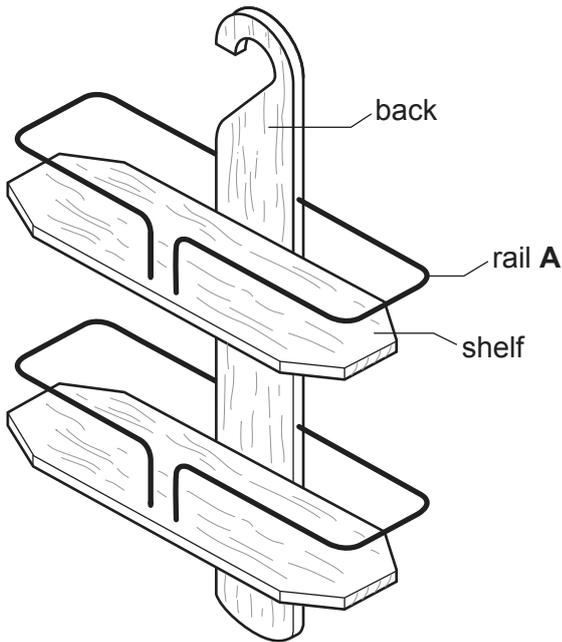


Fig. 11.6

[3]

12 Fig. 12.1 shows an incomplete design for a unit to store items used in a shower room. A parts list gives details of the materials and their sizes.

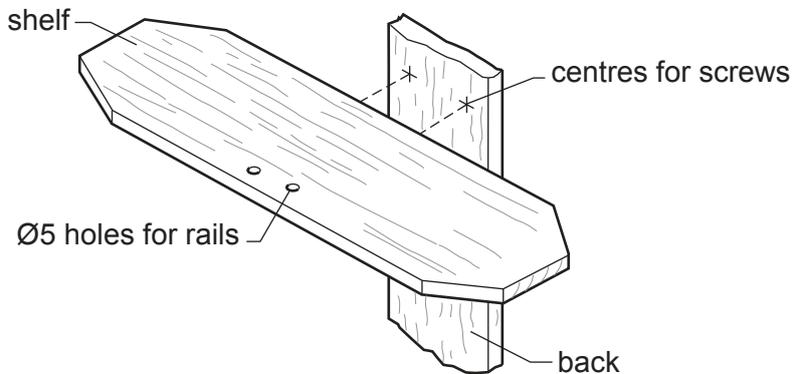


**Parts List**

Part	No.	Size	Material
back	1	480 × 70 × 10	Teak
shelf	2	300 × 90 × 10	Teak
rail	4	450 × Ø5	Aluminium

**Fig. 12.1**

- (a) The back will be screwed and glued to the shelves. Fig. 12.2 shows an exploded view of one shelf and part of the back, showing the positions for the screws.



**Fig. 12.2**

Table 12.1 shows four items of information required when selecting screws. Complete Table 12.1 to give details of suitable screws that could be used to join the shelves to the back of the unit.

**Table 12.1**

Item of information required	Selection
Diameter	
Material	
Length	
Type of head	

[4]

- (b) Fig. 12.3 shows the hook shape of the back of the storage unit marked out, ready to be cut out and shaped. Use sketches and notes to show how the shape could be produced. Name all the tools and equipment used.

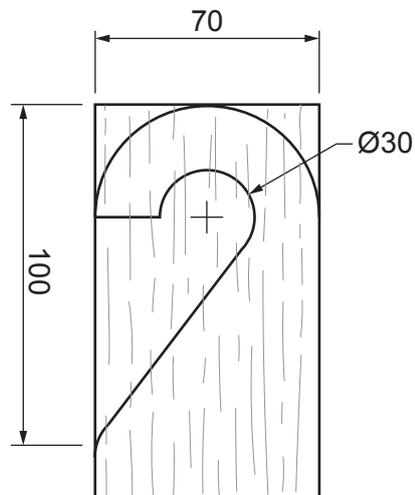


Fig. 12.3

[5]

- (c) (i) Fig. 12.4 shows the dimensions of rail **A** in Fig. 12.1.  
 The rail is made from  $\varnothing 5$  aluminium rod and is bent to shape.  
 Use sketches and notes to show how rail **A** could be produced.  
 Name all the tools and equipment used.

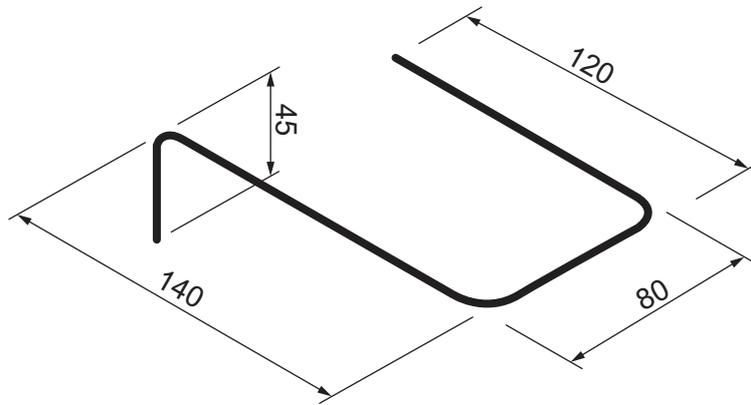


Fig. 12.4

[5]

- (ii) Give **two** reasons why the aluminium rails should be anodised.

1 .....

2 .....

[2]

(iii) The rails will be glued into holes drilled in the back and shelves of the storage unit using an epoxy resin adhesive.

Describe how the adhesive would be prepared before gluing the rails into the holes.

.....  
.....  
..... [2]

(d) When the shower is switched on it is likely that the shelves will become wet. Use sketches and notes to show modifications to the design of the shelves so that any water could drain away.

Give details to show how the modified design could be made in a school workshop.

[5]

(e) Many products used in shower rooms are made entirely of plastic. State **two** properties of plastic that make it suitable for use in a shower room.

1 .....  
2 ..... [2]

- 13 Fig. 13.1 shows views of an incomplete design for an adjustable tray that could be used by a person sitting up in bed.  
 The tray can be used in the flat position or tilted and locked at different angles.  
 The tray is made of manufactured board. The rails and legs are made of hardwood.

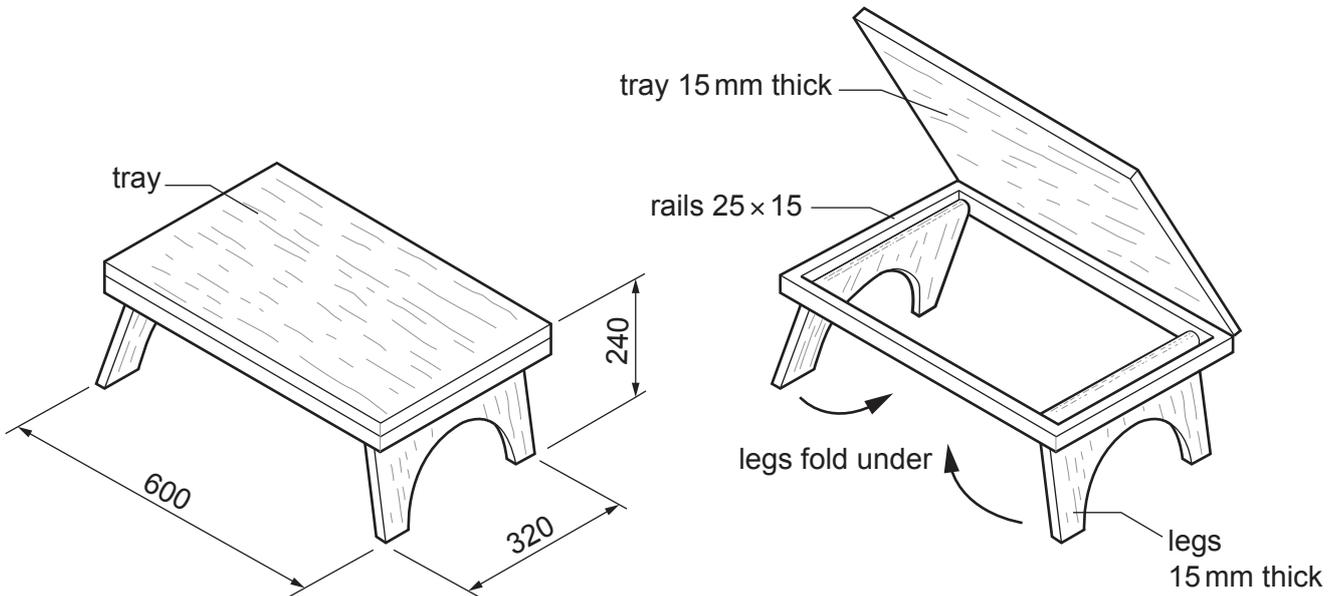


Fig. 13.1

- (a) (i) Name a suitable manufactured board for the tray.

..... [1]

- (ii) Many manufactured boards have veneered surfaces.  
 State **one** benefit and **one** drawback of using veneers to cover the surfaces of manufactured boards used to make furniture products.

Benefit

.....

Drawback

.....

[2]

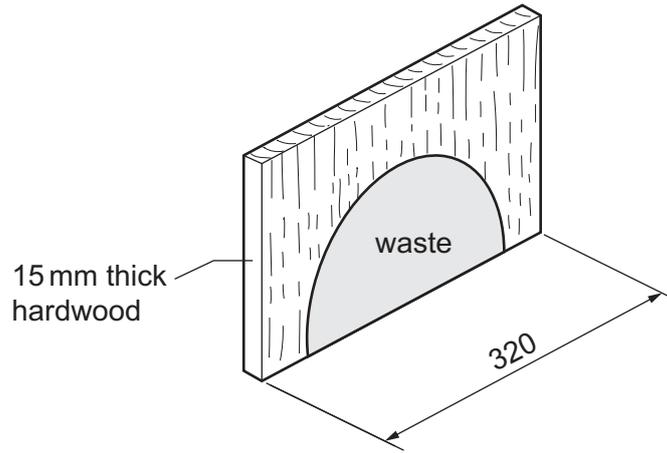
- (b) The top surface of the tray is covered with a plastic laminate.  
 State **two** benefits of covering the top surface of the tray with a plastic laminate.

1 .....

2 .....

[2]

(c) Fig. 13.2 shows one of the legs with the curved shape marked out, ready to be removed.



**Fig. 13.2**

(i) Name a specific type of saw that could be used to remove the waste.

..... [1]

(ii) Give the specific names of **two** tools or items of equipment that could be used to make the sawn edges smooth.

1 .....

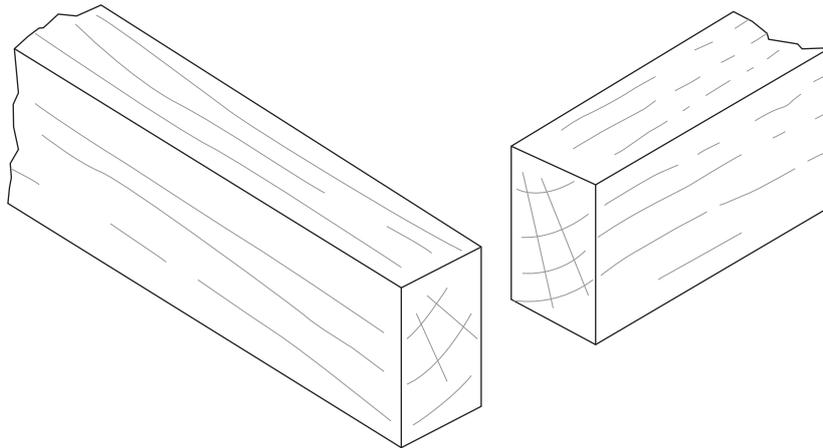
2 .....

[2]

(d) In use, there is a danger that items could slide off the surface of the tray.  
Use sketches and notes to show a modification to the design of the tray that could prevent items from sliding off. Name any materials and constructions used.

[3]

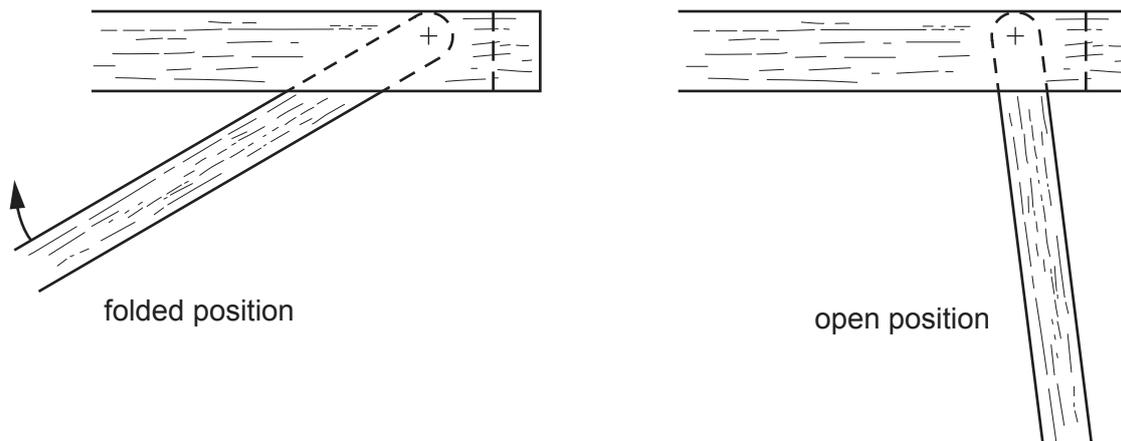
- (e) Fig. 13.3 shows an exploded view of the rails that will be joined at each corner of the adjustable tray.



**Fig. 13.3**

Add sketches to Fig. 13.3 to show a suitable corner construction, other than a butt joint, that could be used to join the rails. [3]

- (f) Fig. 13.4 shows one of the legs of the tray in both an open and folded position.



**Fig. 13.4**

Use sketches and notes to show how the leg could be made to fold underneath in the direction of the arrow shown in Fig. 13.4. Name any materials and fittings used.

- (g) Butt hinges will be used to allow the tray to be tilted at different angles. Fig. 13.5 shows part of a recess,  $50 \times 10$ , cut out in a rail to take one of the butt hinges. Draw on Fig. 13.5 to show a butt hinge screwed into the rail.

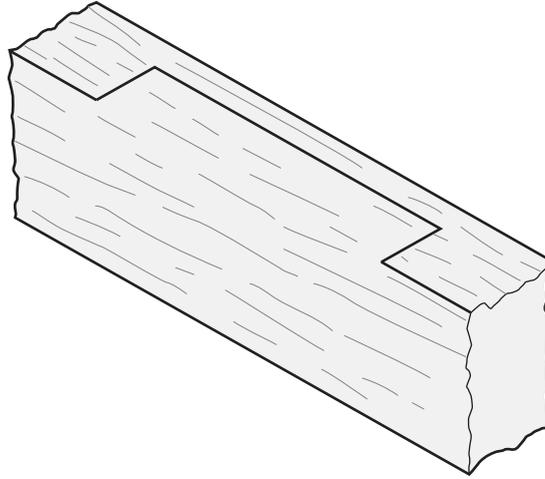
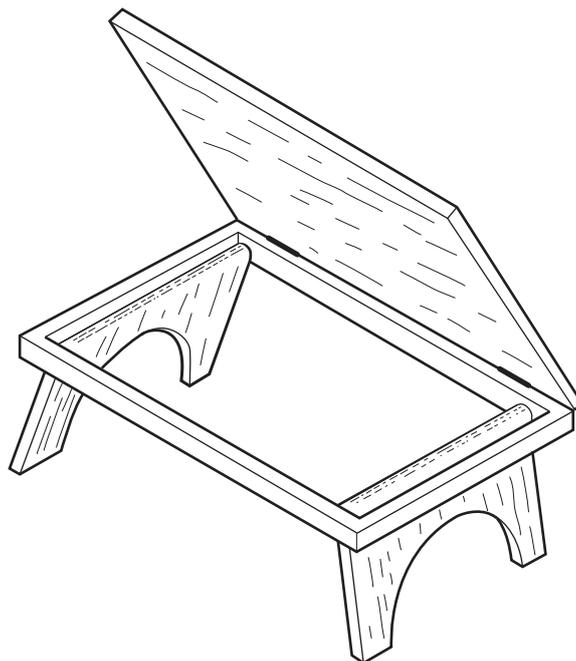


Fig. 13.5

[3]

(h) Fig. 13.6 shows the widest angle at which the tray will be tilted for the comfort of the user.



**Fig. 13.6**

Use sketches and notes to show how the tray could be locked at **four** different angles between closed and fully open.

Give details of all materials and constructions used.

[5]

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