



## Cambridge IGCSE™

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## DESIGN &amp; TECHNOLOGY

0445/31

Paper 3 Resistant Materials

October/November 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 **24** pages. Any blank pages are indicated.



## Section A

Answer **all** questions in this section.

- 1 Fig. 1.1 shows the label from a box of wood screws.

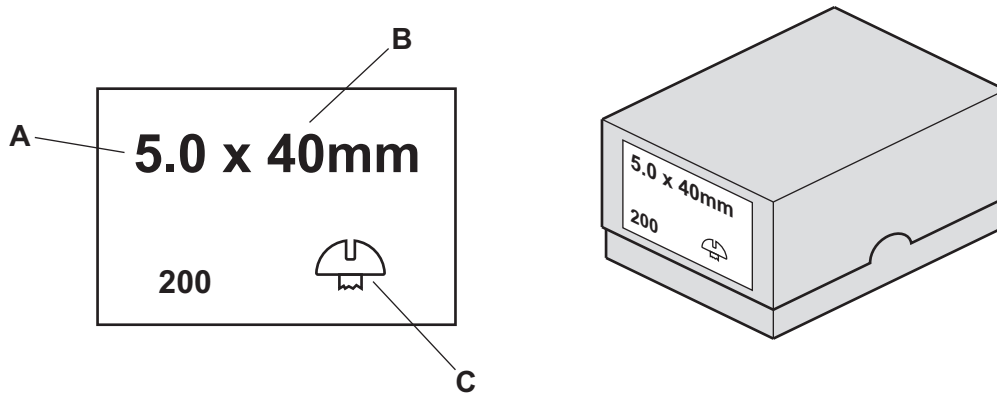


Fig. 1.1

State what is meant by each item labelled **A**, **B** and **C**.

**A** .....

**B** .....

**C** ..... [3]

- 2 Energy can be generated from natural sources.  
State **three** natural sources of energy.

1 .....

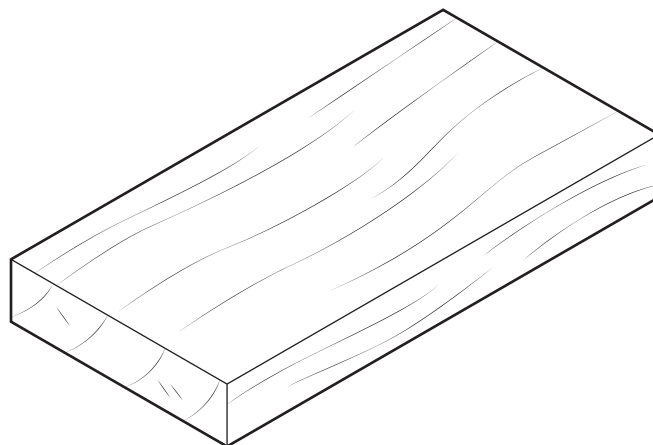
2 .....

3 ..... [3]





3 Fig. 3.1 shows a block of softwood 20 mm thick.

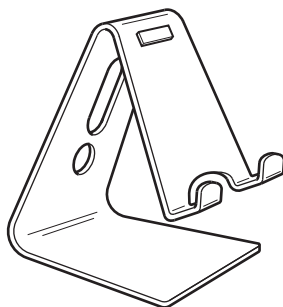


**Fig. 3.1**

Draw a groove on the softwood block shown in Fig. 3.1.

[2]

4 Fig. 4.1 shows a mobile phone holder made from aluminium.



**Fig. 4.1**

Identify **three** design features of the mobile phone holder shown in Fig. 4.1.

- 1 .....
- 2 .....
- 3 .....

[3]





5 Fig. 5.1 shows a sign holder made from 1.5mm thick mild steel sheet.

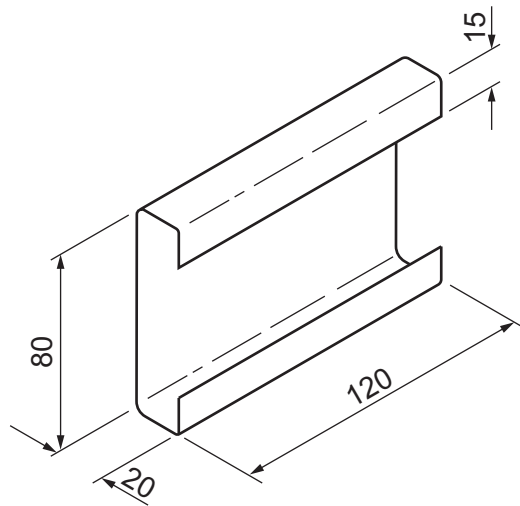


Fig. 5.1

Use sketches and notes to show how a batch of **ten** identical sign holders could be produced in a school workshop. Name all the tools and equipment used.

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- 6 Fig. 6.1 shows a split pattern made of wood.  
The split pattern will be used to make an aluminium handle for a hacksaw.

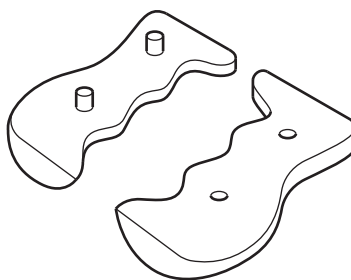


Fig. 6.1

Name the process that will be used to make the hacksaw handle using the split pattern.

..... [1]

- 7 Fig. 7.1 shows a dish that has been shaped from thin copper sheet and a process that is carried out during its manufacture.

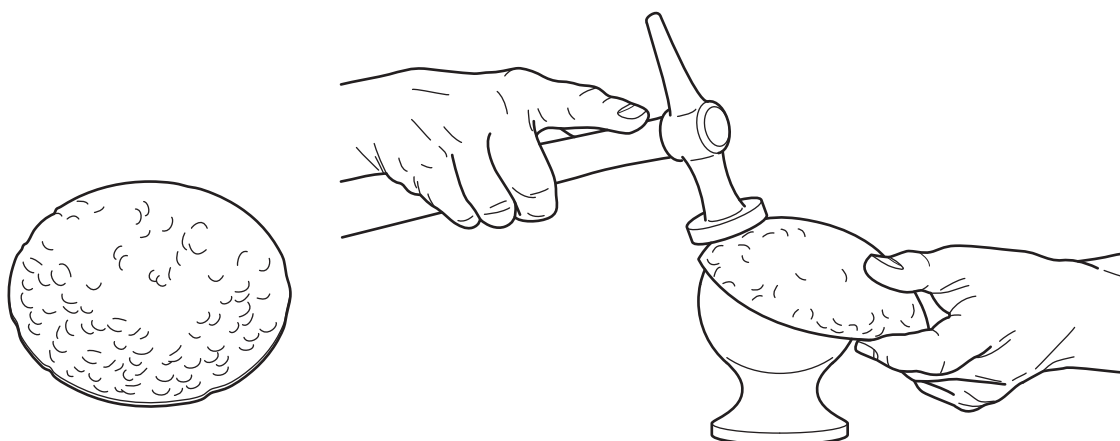


Fig. 7.1

- (a) Name the process shown in Fig. 7.1.

..... [1]

- (b) Give **two** reasons why the process is carried out on the copper sheet.

1 .....

2 .....

[2]





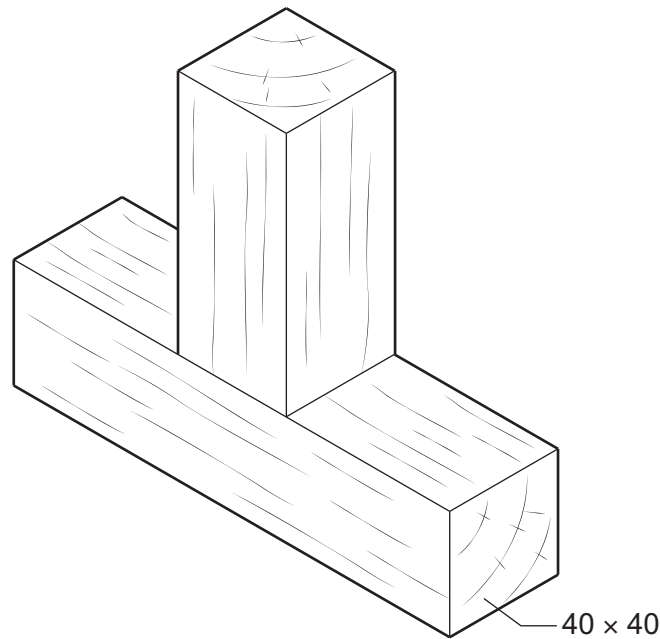
- 8 Shape memory alloy (SMA) is a smart material.  
The most common shape memory alloy (SMA) is Nitinol.  
Complete the names of the **two** metals that are combined to make Nitinol.

N .....

T .....

[2]

- 9 Fig. 9.1 shows two lengths of softwood glued together.



**Fig. 9.1**

Add sketches and notes to Fig. 9.1 to show how the joint could be strengthened.  
State how any additional materials are attached to the softwood.

[3]





10 Fig. 10.1 shows a food container made from plastic with an integral lid.



Fig. 10.1

Give **one** benefit of an integral lid.

.....

..... [1]





## Section B

Answer **one** question from this section.

- 11 Fig. 11.1 shows a condiment holder that has been designed and made by a group of Design & Technology students. The condiment holder is made mainly from softwood and will be used in the school dining hall.

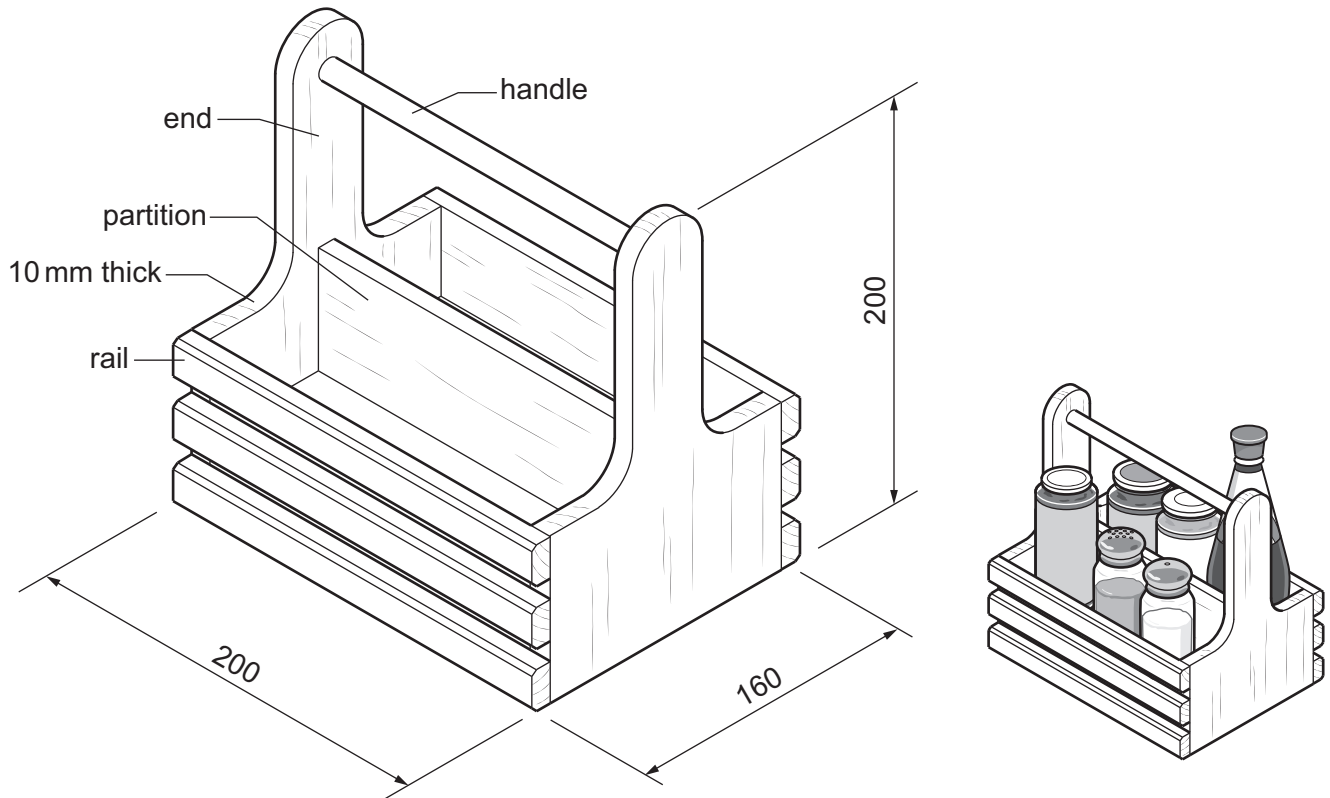


Fig. 11.1

- (a) State **three** questions the students could have asked the catering staff to help them design the condiment holder.

- 1 .....
- 2 .....
- 3 ..... [3]

- (b) (i) Give **one** reason for making the condiment holder from softwood rather than hardwood.

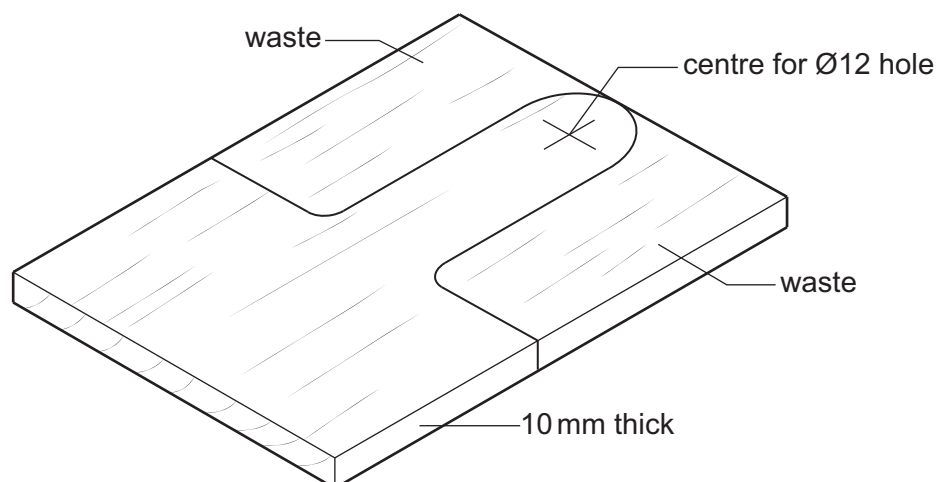
..... [1]

- (ii) Name a suitable manufactured board that could be used for the 5 mm thick base of the holder.

..... [1]



(c) Fig. 11.2 shows one end of the holder marked out, ready to be cut to shape.



**Fig. 11.2**

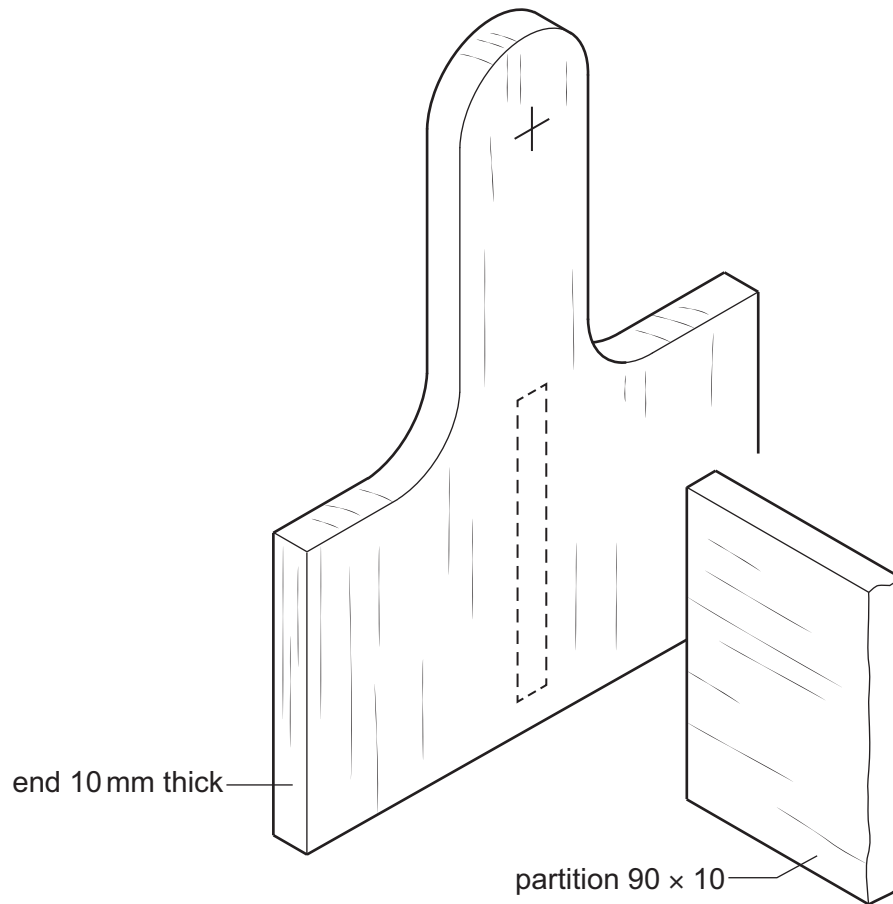
Use sketches and notes to show how the waste could be removed and the edges made smooth. Name all the tools and equipment used.

[4]





(d) Fig. 11.3 shows the position where the partition will be joined to an end.



**Fig. 11.3**

Sketch and name a suitable construction that could be used to join the partition to the end.



- (e) A batch of ten holders is to be produced.  
Use sketches and notes to show a design for a jig that could be used to saw 200 mm lengths of softwood for the rails of the condiment holder.

[4]

- (f) Fig. 11.4 shows one of the rails with the edges planed to produce a chamfer.

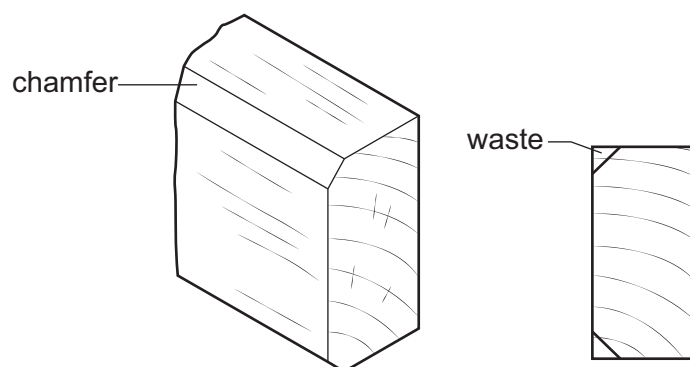


Fig. 11.4

- (i) Use sketches and notes to show how the length of softwood for the rail could be held while **one** edge is planed.

[2]

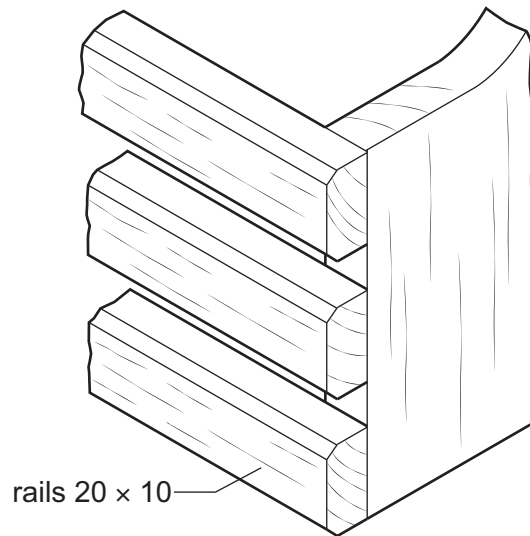
- (ii) Name a specific type of plane that could be used to remove the waste.

[1]





(g) Fig. 11.5 shows three rails joined to an end using nails and an adhesive.



**Fig. 11.5**

(i) Name a specific type of nail that could be used to join the rails to the ends.

..... [1]

(ii) Name a tool that could be used to sink the head of the nail below the surface of the softwood.

..... [1]

(h) Describe how the success of the design of the holders could be evaluated by the Design and Technology students.

.....

.....

.....

.....

.....

..... [3]





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- 12 Fig. 12.1 shows views of an incomplete design for a freestanding clock made from acrylic. The clock mechanism and the clock hands have been removed.

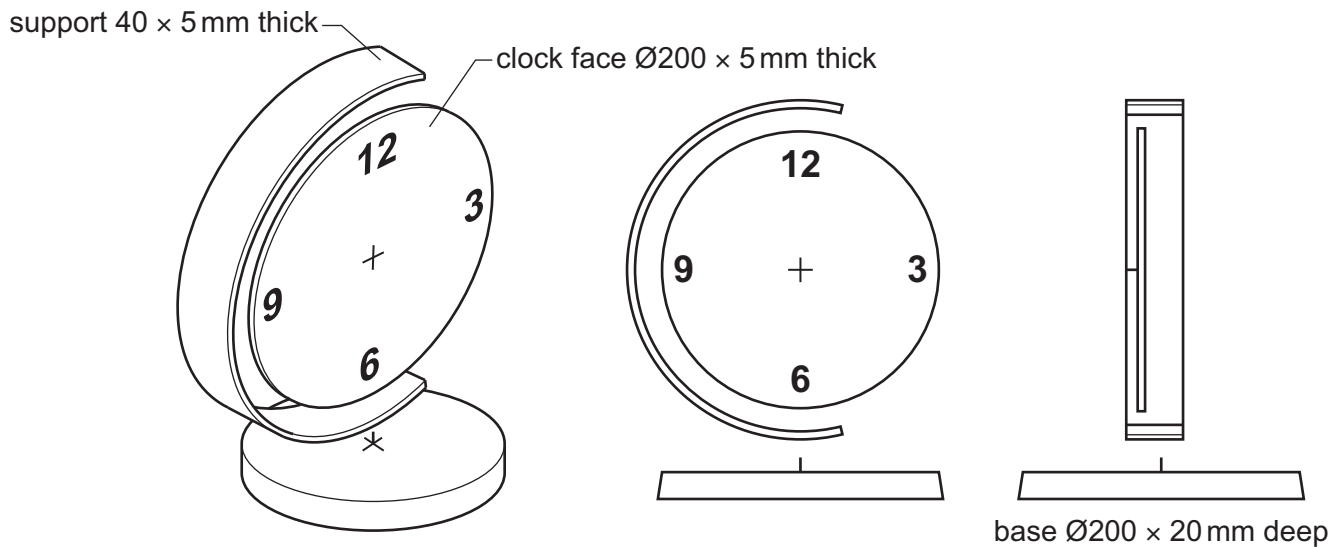


Fig. 12.1

- (a) Table 12.1 shows a list of statements. Complete Table 12.1 by indicating with a tick (✓) the **two** statements that apply to acrylic.

Table 12.1

| Statement               | Tick (✓) |
|-------------------------|----------|
| Impact resistant        |          |
| A thermosetting plastic |          |
| Scratch resistant       |          |
| Can be self-finished    |          |
| Does not splinter       |          |

[2]

- (b) The support shown in Fig. 12.1 is made by bending a strip of acrylic  $500 \times 40 \times 5$  to shape. The strip will be finished to a high quality before it is bent to shape.
- (i) Complete Table 12.2 by stating **three** processes that need to be carried out to the edges of the strip to produce a high-quality finish.

Table 12.2

| Stage | Processes |
|-------|-----------|
| 1     |           |
| 2     |           |
| 3     |           |

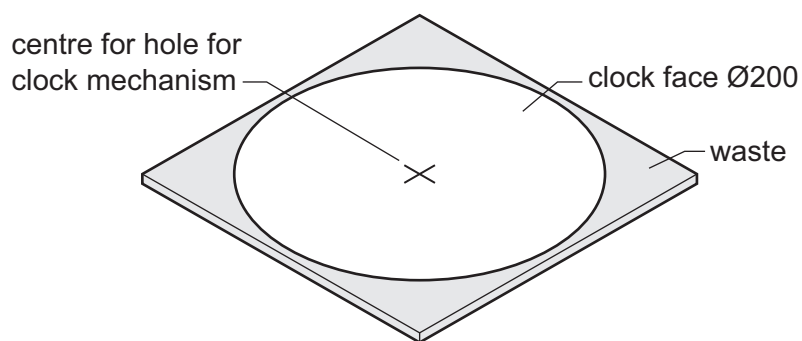
[3]



- (ii) Use sketches and notes to show how the 500 mm length of acrylic could be bent to the shape of the support.  
Name all the tools and equipment used.

[4]

- (c) Fig. 12.2 shows the clock face marked out on a sheet of 5 mm thick acrylic.



**Fig. 12.2**

Give the name of each tool that could be used when carrying out the following processes to produce the clock face:

- (i) marking out the circular shape.

..... [1]

- (ii) cutting out the circular shape.

..... [1]





- (d) A  $\varnothing 5$  hole will be drilled through the clock face shown in Fig. 12.2 for the clock mechanism. State **two** precautions that must be taken to prevent damage to the clock face when drilling the hole.

1 .....

2 ..... [2]

- (e) The numbers 3, 6, 9 and 12 will be designed using CAD. Describe how CAM could be used to produce the numbers 3, 6, 9 and 12 on the clock face.

.....

.....

.....

.....

..... [4]

- (f) The base of the clock will be vacuum formed. Fig. 12.3 shows the mould for the base of the clock positioned on the platen, ready to be vacuum formed.

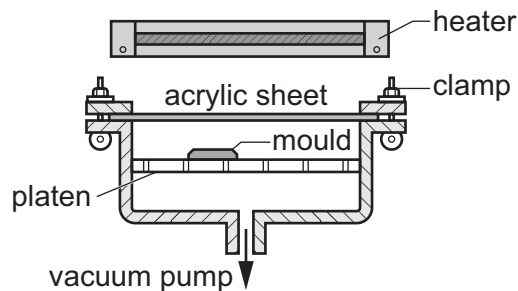


Fig. 12.3

Complete Table 12.3 by stating **four** additional processes that need to be carried out to vacuum form the base.

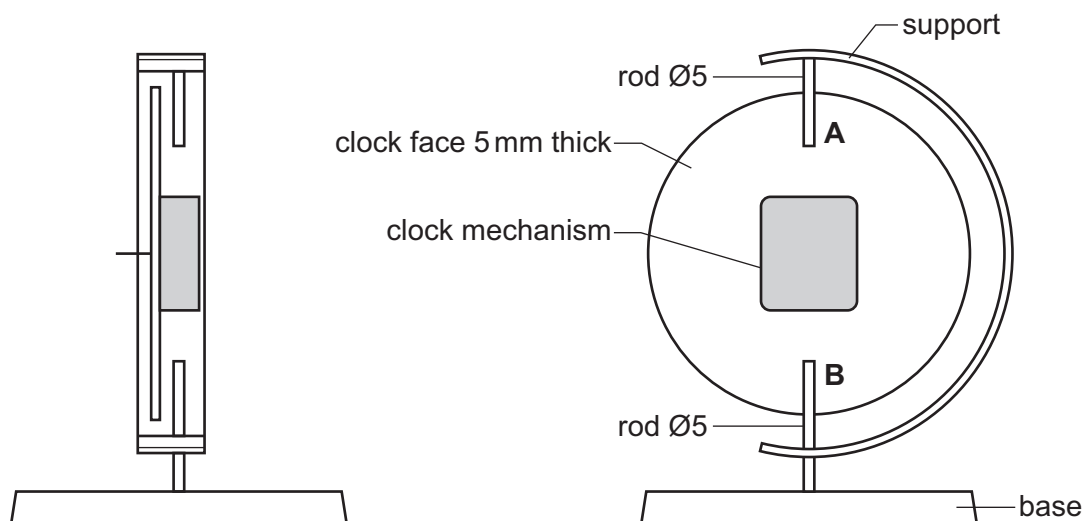
Table 12.3

| Stage | Processes          |
|-------|--------------------|
| 1     | Turn the heater on |
| 2     |                    |
| 3     |                    |
| 4     |                    |
| 5     |                    |

[4]



- (g) Fig. 12.4 shows views of the side and back of the clock. The clock face will be joined to the base and support using two Ø5 acrylic rods labelled **A** and **B**.



**Fig. 12.4**

Use sketches and notes to show how the clock face could be joined to the Ø5 acrylic rods. Give details of all materials and constructions used.



13 Fig. 13.1 shows a photo frame made of hardwood supported on a stand made from mild steel.

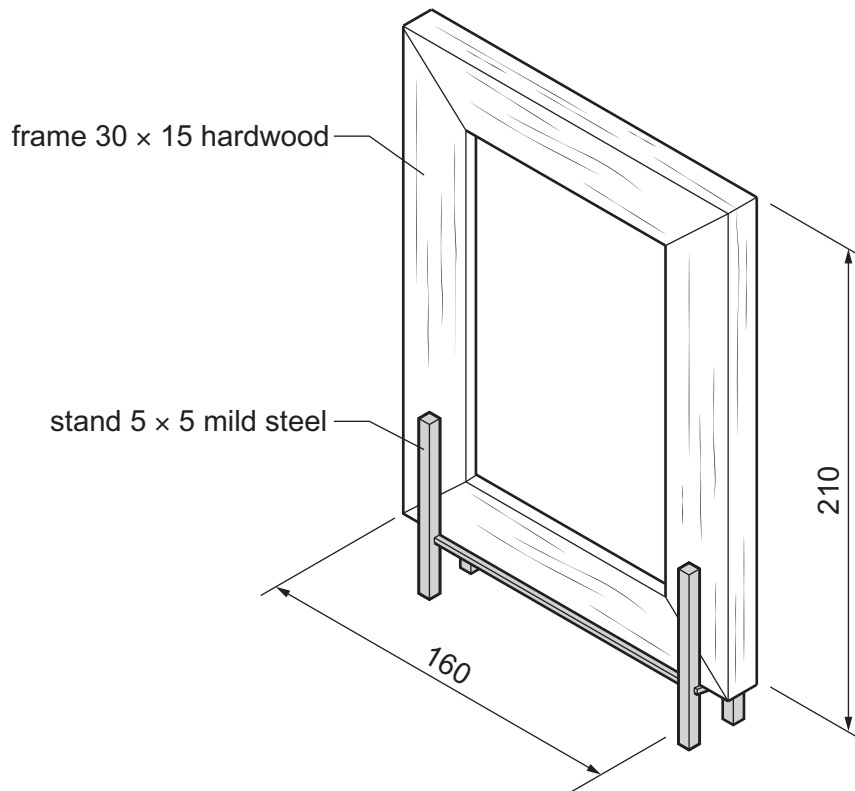


Fig. 13.1

(a) Circle, from the list below, **two** hardwoods that could be used to make the photo frame.

cedar

parana pine

beech

whitewood

oak

[2]



(b) Fig. 13.2 shows one of the sides of the frame with mitres marked out on each end.

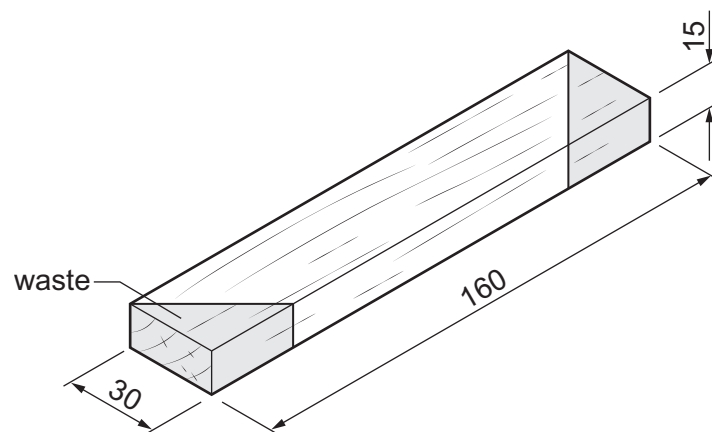


Fig. 13.2

Fig. 13.3 shows two tools, **A** and **B**, that could be used to mark out the mitres.

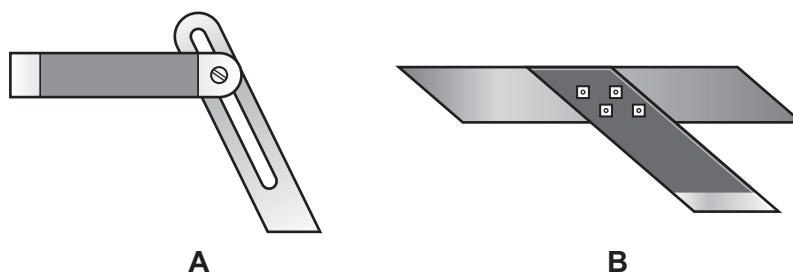


Fig. 13.3

(i) State the name of tool **A** and tool **B**.

**A** .....

**B** .....

[2]

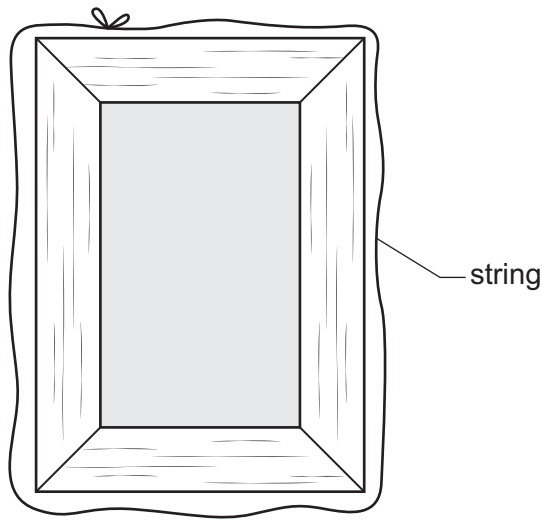
(ii) Use sketches and notes to show how the waste shown in Fig. 13.2 could be removed and the surfaces made flat to produce an accurate mitre joint.  
Name all the tools and equipment used.

[3]

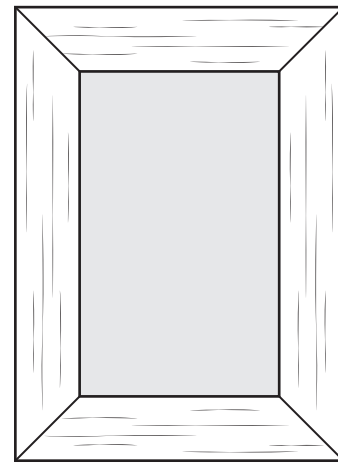


(c) Fig. 13.4 shows the sides of the frame glued together and held in place using string.

- (i) Add sketches and notes to Fig. 13.5 to show how the string could be tensioned to hold the sides of the frame in place.



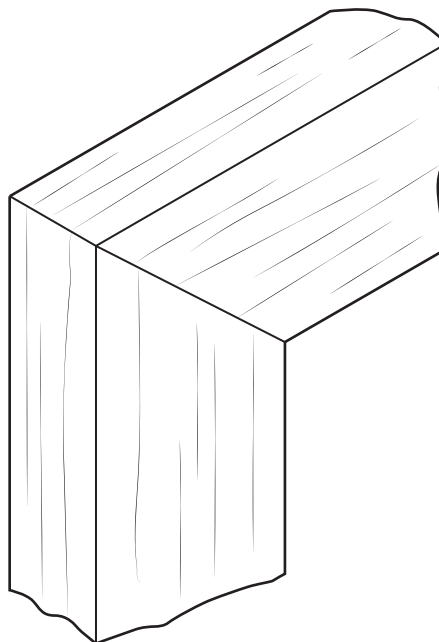
**Fig. 13.4**



**Fig. 13.5**

[2]

- (ii) Fig. 13.6 shows one corner of the photo frame.



**Fig. 13.6**

Add sketches and notes to Fig. 13.6 to show how the mitre joint could be strengthened. The method must make the joint look attractive.

[3]





- (d) Fig. 13.7 shows details of the stand into which the photo frame will fit.  
The legs of the stand will be cut from a length of 5 × 5 mild steel bar.

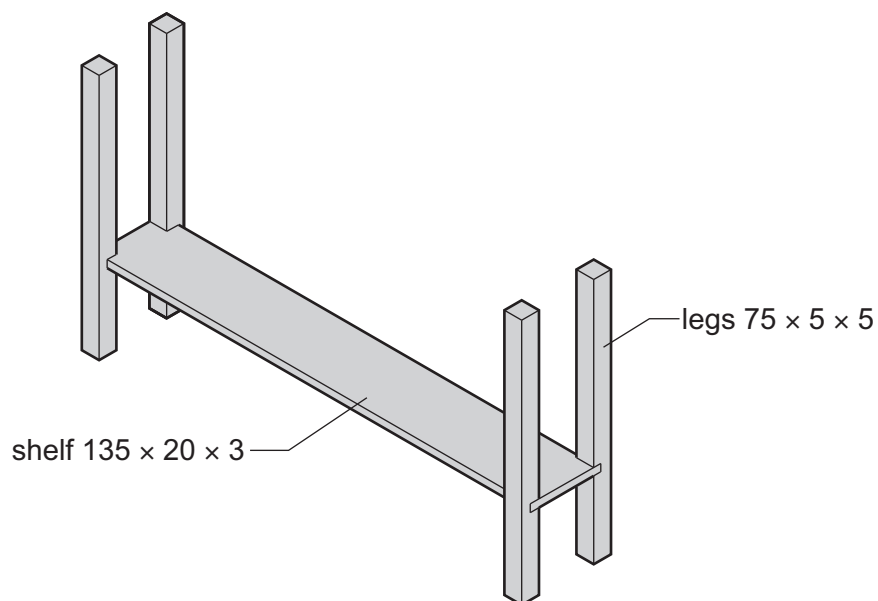
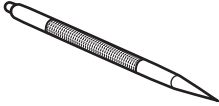
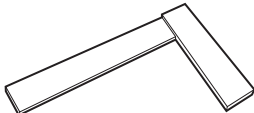


Fig. 13.7

- (i) Complete Table 13.1 by naming the tools that could be used to mark out the lengths of the legs on the mild steel bar.

Table 13.1

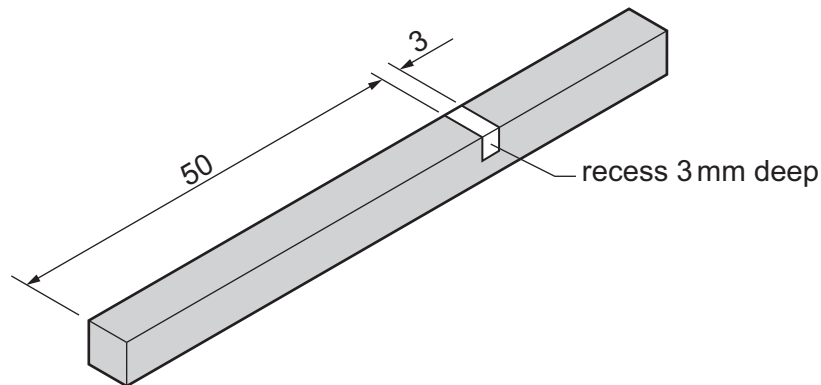
| Tool                                                                                | Name of tool |
|-------------------------------------------------------------------------------------|--------------|
|  | .....        |
|  | .....        |

[2]





- (ii) Fig. 13.8 shows one of the legs with the recess for the shelf marked out ready to be cut out. It is important that the recesses are cut out accurately in all four legs.



**Fig. 13.8**

Use sketches and notes to show how all **four** recesses could be cut out accurately to allow the shelf to fit.

Name all the tools and equipment used.

[4]

- (e) The shelf will fit into the recesses in the legs and be joined by brazing.

Complete Table 13.2 by stating the purpose of each item of equipment/material used in the brazing process.

**Table 13.2**

| Equipment/material | Purpose |
|--------------------|---------|
| emery cloth        |         |
| flux               |         |
| blowtorch          |         |
| brazing rod        |         |

[4]





- (f) Use sketches and notes to show how the stand could be modified to improve the stability of the photo frame.

[3]





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