AQA

Surname _____

Forename(s) _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

A-level

DESIGN AND TECHNOLOGY: PRODUCT DESIGN

Paper 1   Technical Principles

7552/1

Wednesday 7 June 2023   Afternoon

Time allowed: 2 hours 30 minutes

[Turn over]

At the front of this book, write your surname and forename(s), your centre number, your candidate number and add your signature.

MATERIALS

For this paper you must have:

- **normal writing and drawing materials**

- **a scientific calculator.**

INSTRUCTIONS

- **Use black ink or black ball-point pen. Use pencil only for drawing.**

- **Answer ALL questions.**

- **You must answer the questions in the spaces provided. Do not write on blank pages.**

- **If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).**

- **Do all rough work in this book. Cross through any work you do not want to be marked.**

INFORMATION

- **The marks for questions are shown in brackets.**

- **The maximum mark for this paper is 120.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

0 3

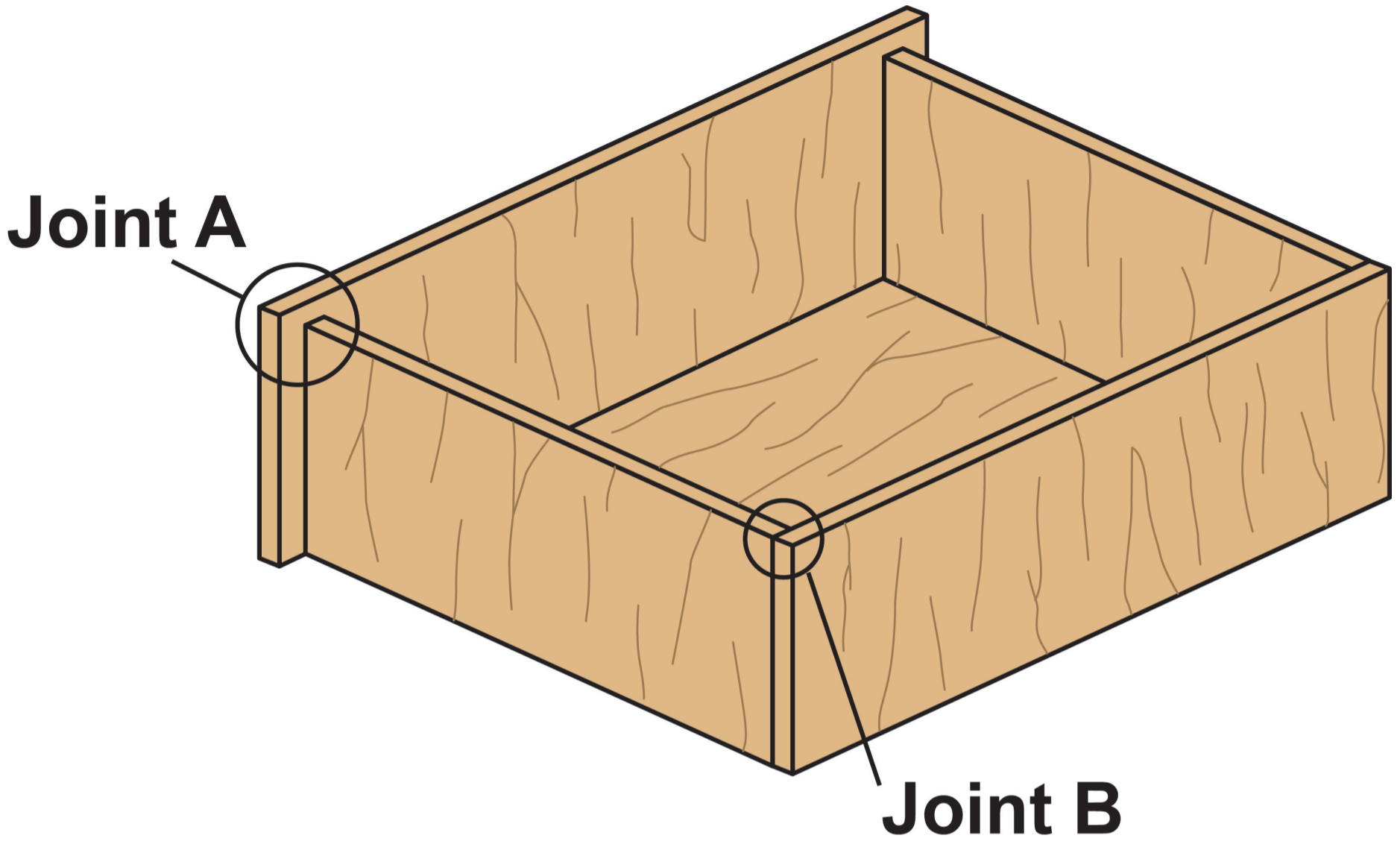**Answer ALL questions in the spaces provided.**

0 1

FIGURE 1, on the opposite page, shows a labelled diagram of a hardwood drawer.

For both of the joints labelled, state an appropriate traditional wood joint.

Do NOT use any traditional wood joint more than once. [2 marks]

FIGURE 1

Joint A

Joint B

Joint A _____

_____

_____

Joint B _____

_____

_____

[Turn over]

0 2 . 1

Describe how a piezo electric material functions. [2 marks]

_____

_____

_____

_____

_____

0 2 . 2

Give a specific example of where piezo electric material may be used. [1 mark]

_____

_____

5

0	3

FIGURE 2, on page 8, shows a dimensioned orthographic drawing of a component.

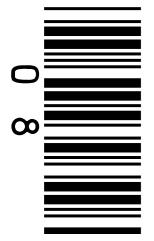**The diagram is not drawn to scale.**

All dimensions in mm

[Turn over]
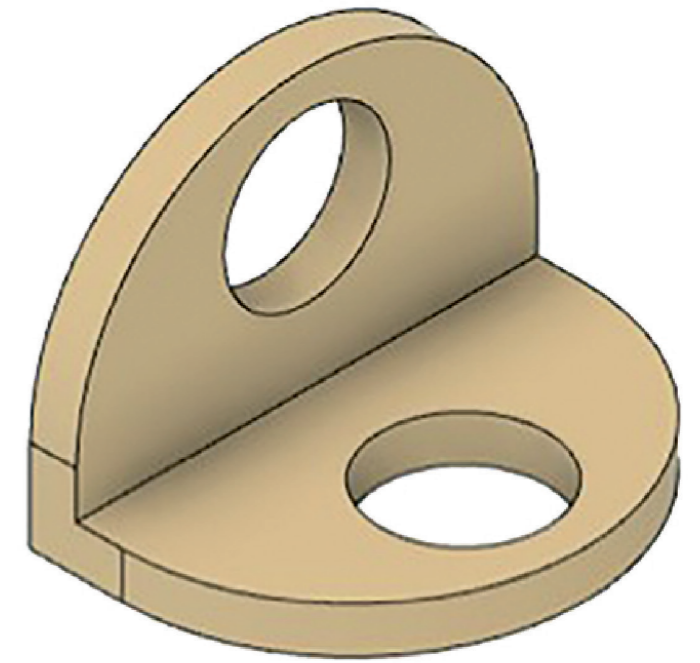
FIGURE 2

Ø18

R25

5

35

35

5

Ø18

R25

50
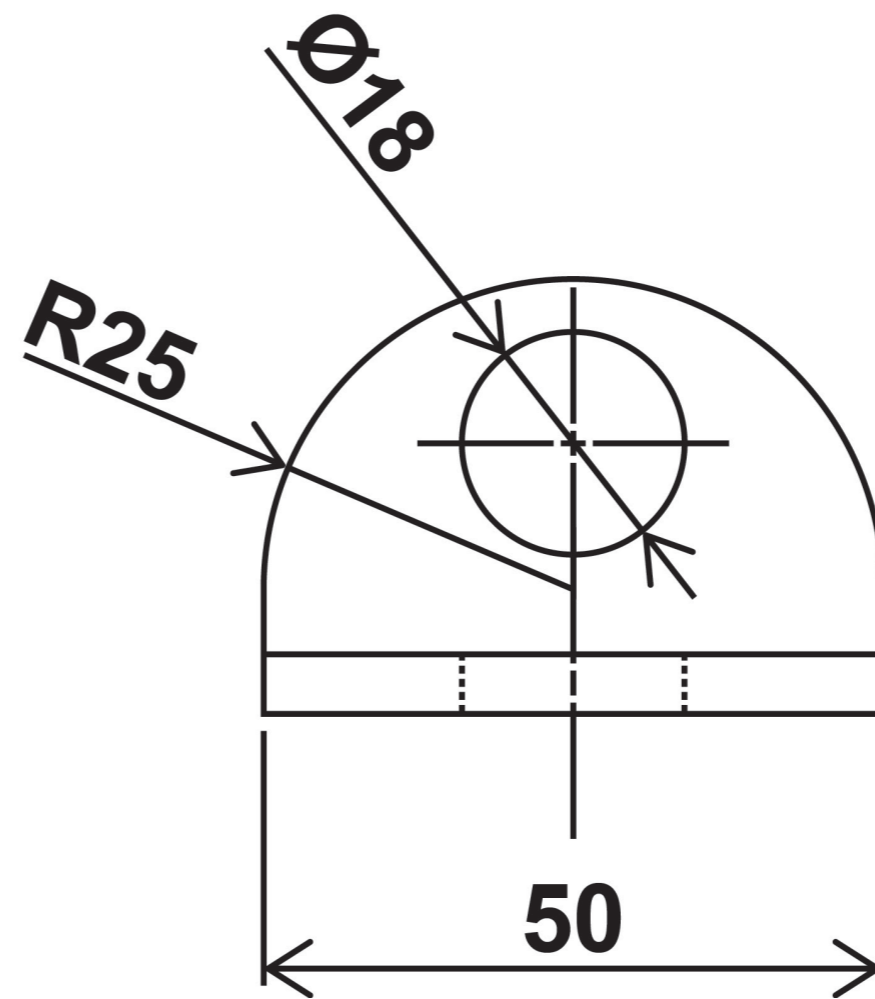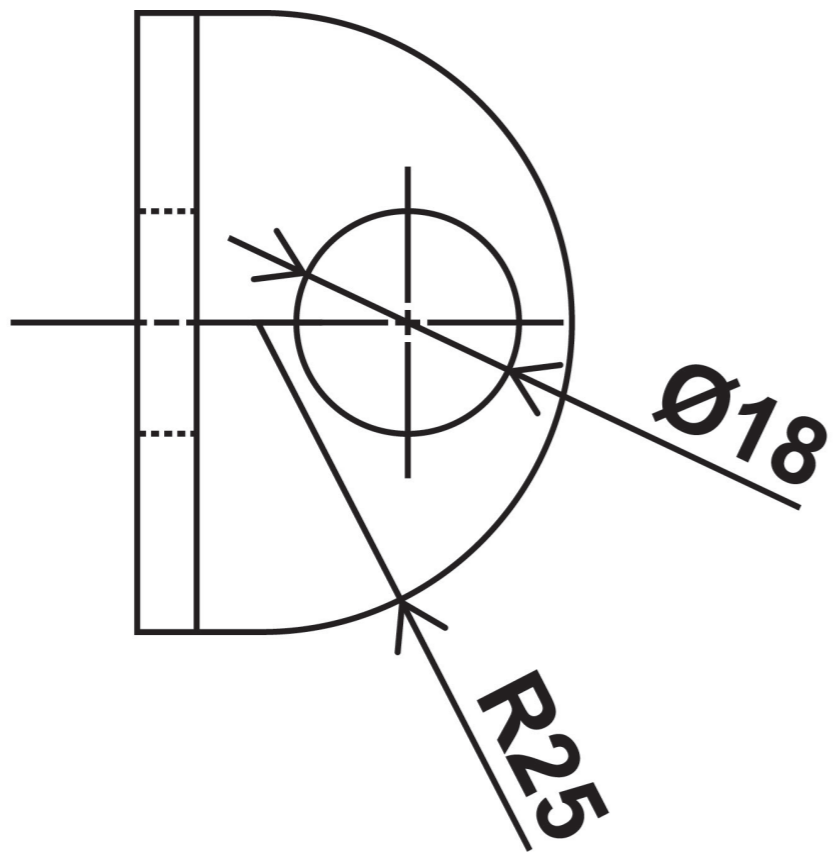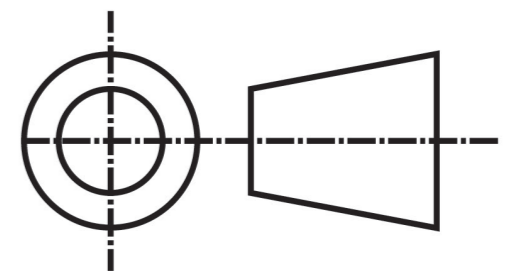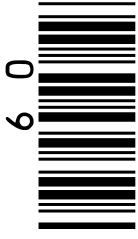
Component 8

Calculate the volume of the component.

Show your working out. [4 marks]

_____

_____

_____

_____

_____

_____

_____

Answer _____ **mm^3**

[Turn over]

4

04 Compare and evaluate the suitability of Acrylonitrile Butadiene Styrene (ABS) and Polylactic Acid (PLA) for the manufacture of a 3D printed component.
[6 marks]

_____

_____

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[Turn over]

0 5

Explain why High Impact Polystyrene (HIPS) is an appropriate material for the manufacture of the protractor shown in FIGURE 3. [6 marks]

FIGURE 3

_____

_____

_____

_____

12
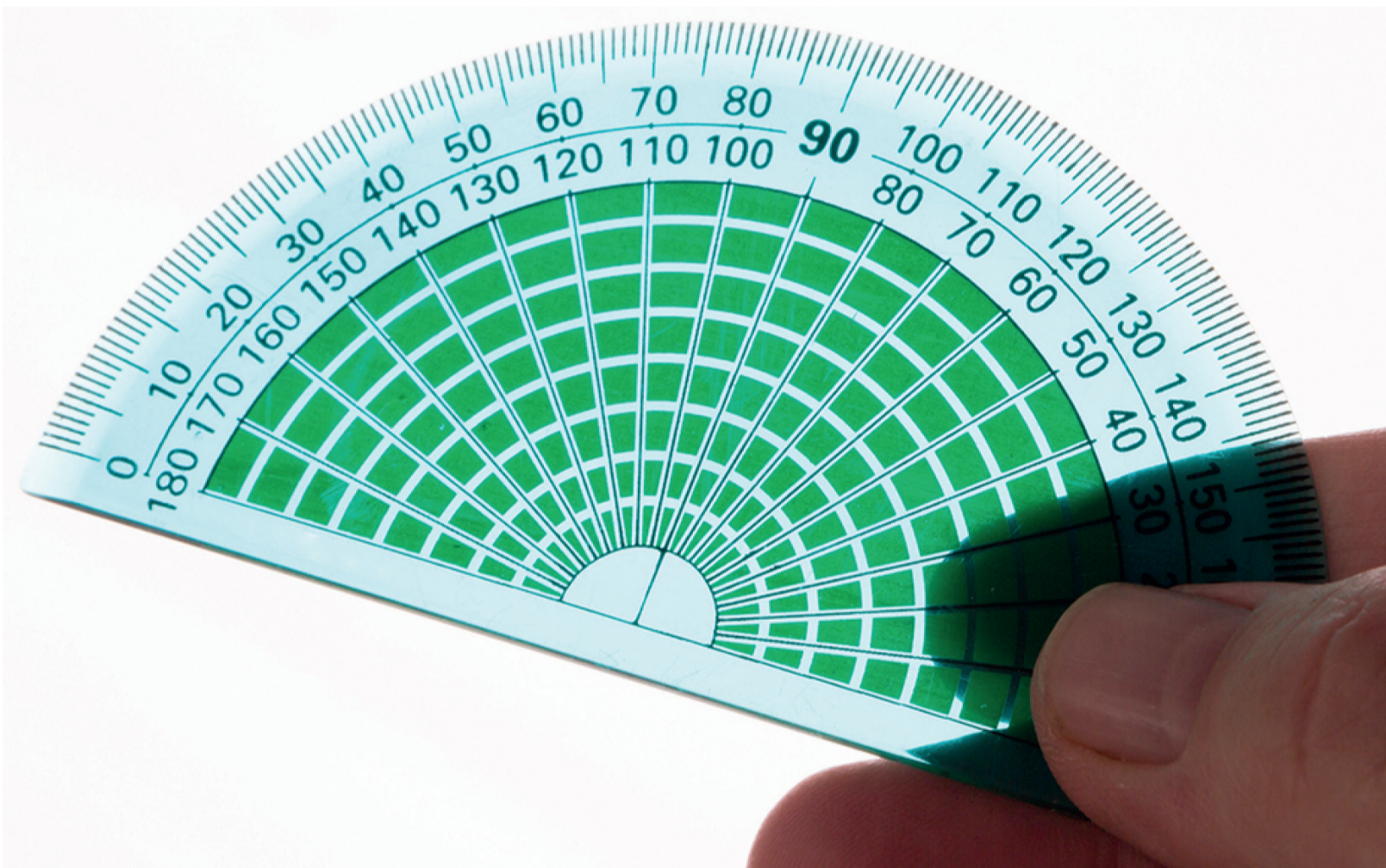
0 6 . 1

FIGURE 4, on the opposite page, shows a side view representing a child's art easel.

The support bar is located 600 mm from the top of the easel.

Calculate the length of the support bar.

Show your working out. [2 marks].

_____

_____

_____

_____

_____

_____

Answer _____ mm

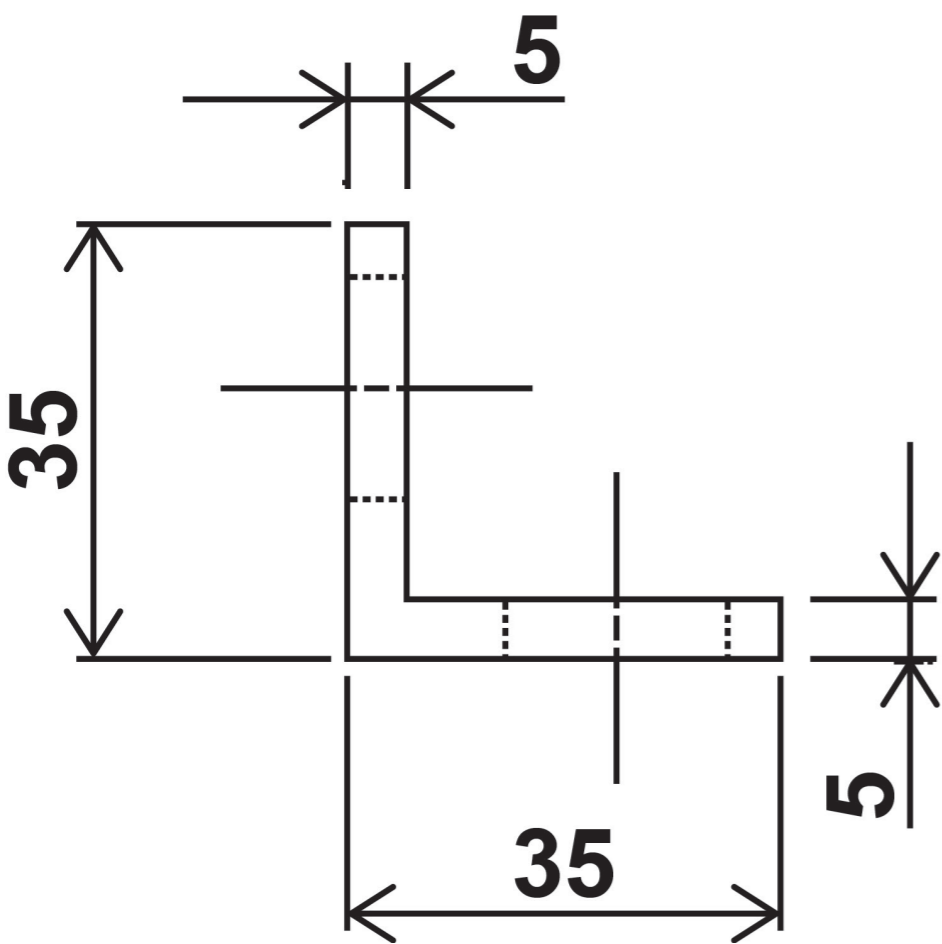**FIGURE 4**

The diagram is not drawn to scale.

All dimensions in mm

Angle of apex

30°

1000
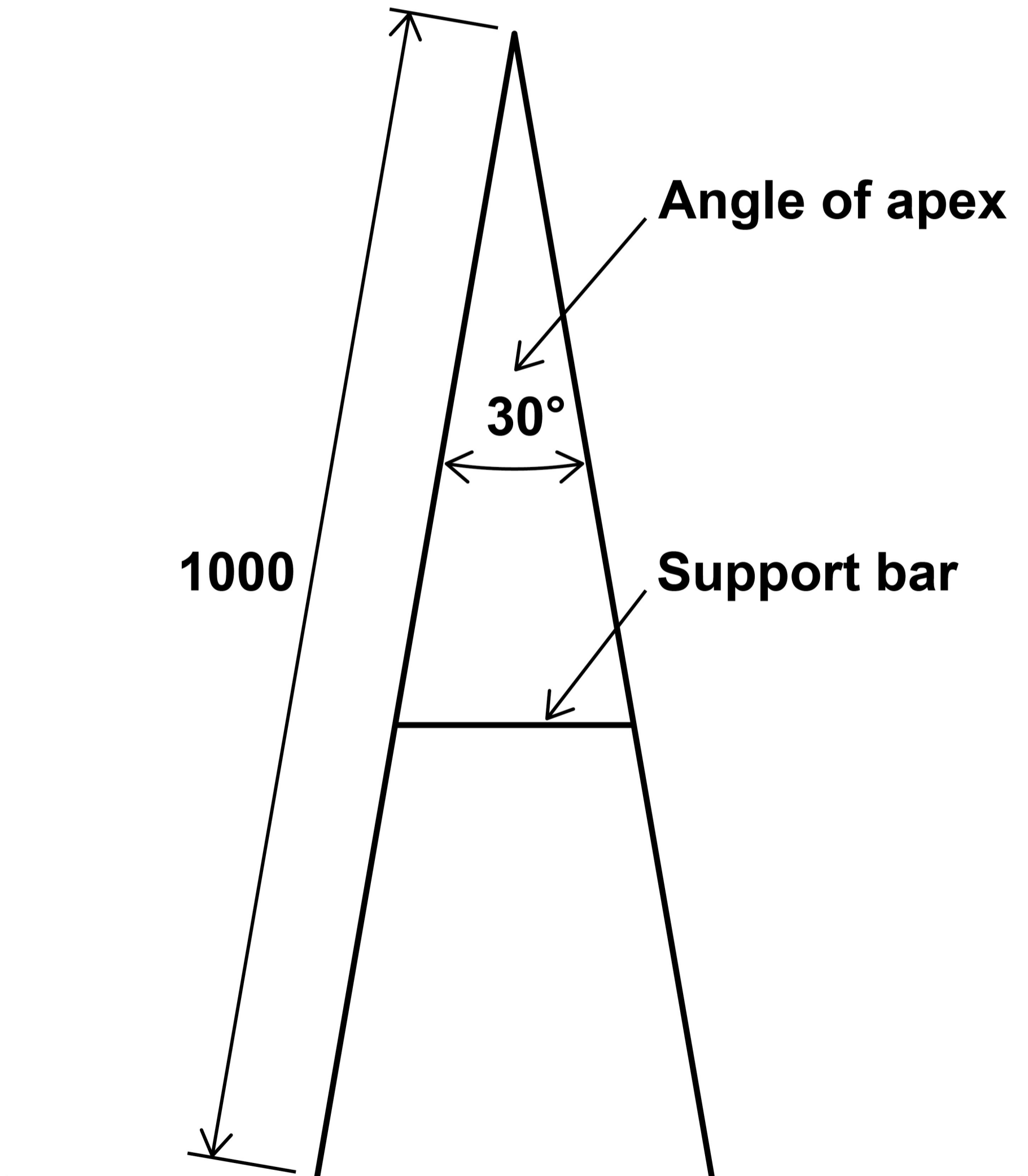
Support bar

0 6 . 2

Consumers have raised issues with the stability of the easel and the manufacturer has decided to increase the length of the support bar to 400 mm.

The support bar remains at 600 mm from the top of the easel.

Calculate the new angle of the apex of the easel.

Give your answer to TWO decimal places. [2 marks]

_____

_____

_____

_____

_____

Answer _____ °

| 0 | 6 | . | 3 |

Calculate the new distance between the feet of the easel on the ground.
[2 marks]

_____

_____

_____

_____

_____

Answer _____ **mm**

[Turn over]

6

0	7

Analyse and evaluate the suitability of rotational moulding for the manufacture of the child's art easel shown in FIGURE 5. [6 marks]

FIGURE 5

Rotationally moulded component

_____

_____

_____

_____

_____

_____

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0	8

FIGURE 6, on pages 22 and 23, shows the results of a Finite Element Analysis (FEA) simulation where a load has been placed on a bracket.

A key for FIGURE 6 is provided on page 23.

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[Turn over]

FIGURE 6

**von Mises
(N/mm^2 (MPa))**

49.846

44.862

39.878

34.894

29.910

24.926

19.942

14.958

9.974

4.990

0.006
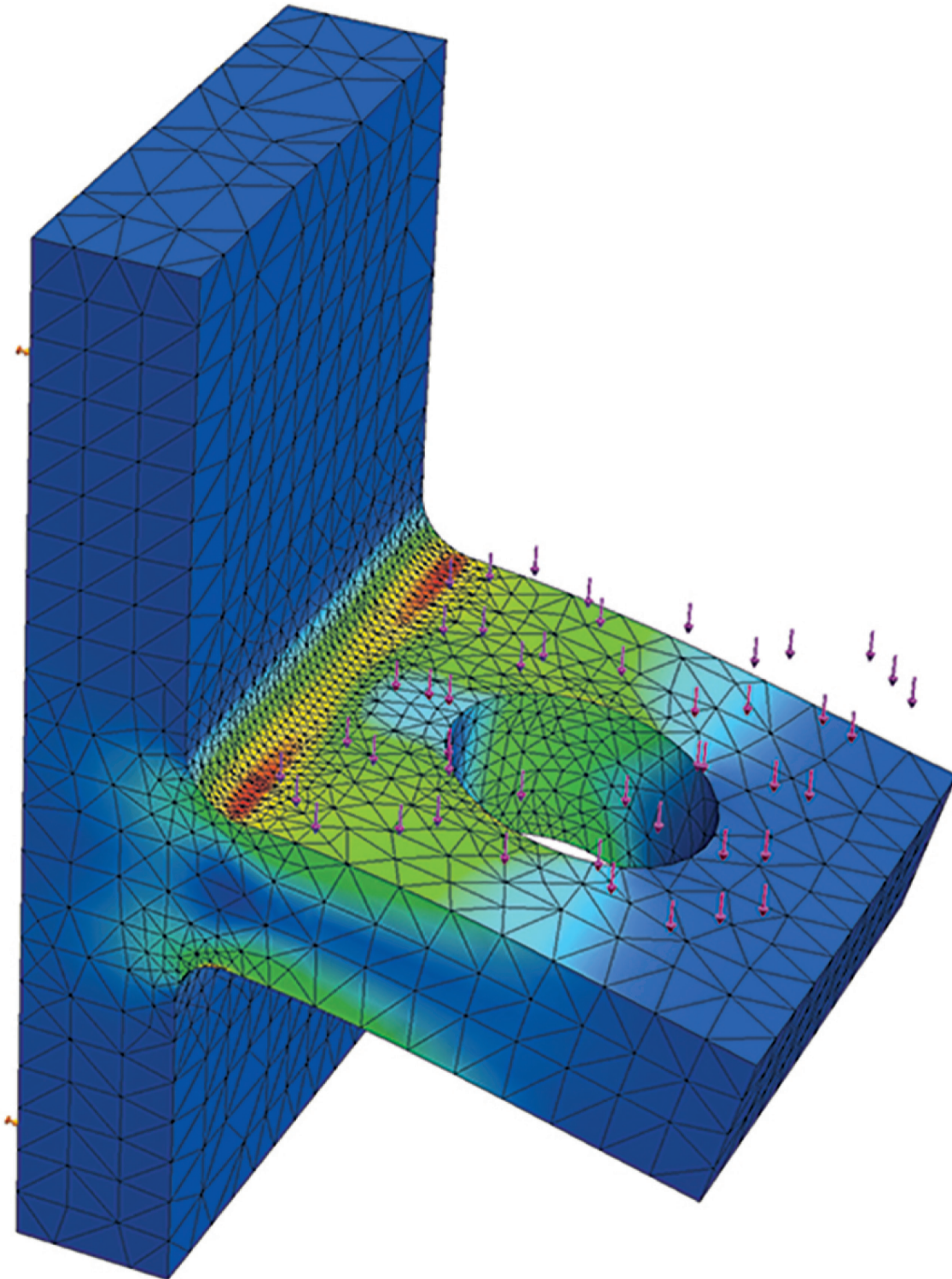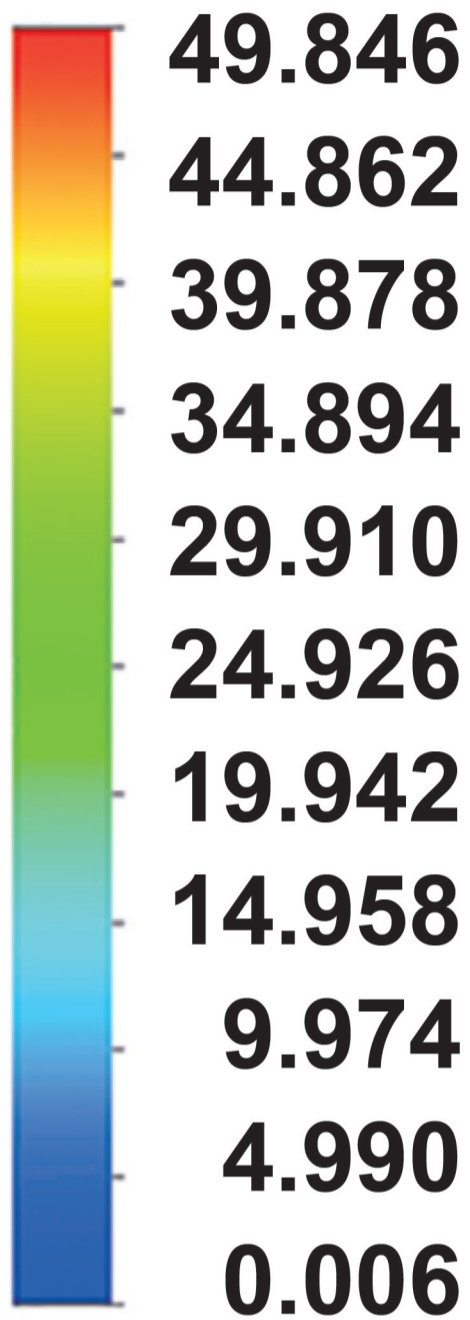
→ **Yield strength:
206.807**

[Turn over]

Describe how a designer would interpret and use the information obtained from the results of the virtual modelling technique shown in FIGURE 6, on pages 22 and 23. [6 marks]

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[Turn over]

12

0 9

Discuss the advantages and disadvantages surrounding the use of software updates as part of the ongoing maintenance of electronic products.
[9 marks]

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9

1	0

Explain why teak is an appropriate material for the manufacture of the sun lounger shown in FIGURE 7. [6 marks]

FIGURE 7

6

1 1

FIGURE 8 shows the cross section of a piece of material that has been subjected to a hardness test.

TABLE 1, on page 32, shows the results of three other materials that have also been tested.

The hardness test has been completed using a 4 mm diameter steel ball.

The ball has been indented to its full diameter. [3 marks]

FIGURE 8

The diagram is not drawn to scale.

All dimensions in mm

Material D

Calculate the volume of the indentation and complete TABLE 1, on page 32.

Volume of a sphere V = $\dfrac{4}{3}\pi r^3$

_____

_____

_____

_____

_____

_____

_____

_____

Answer _____ **mm^3**

[Turn over]
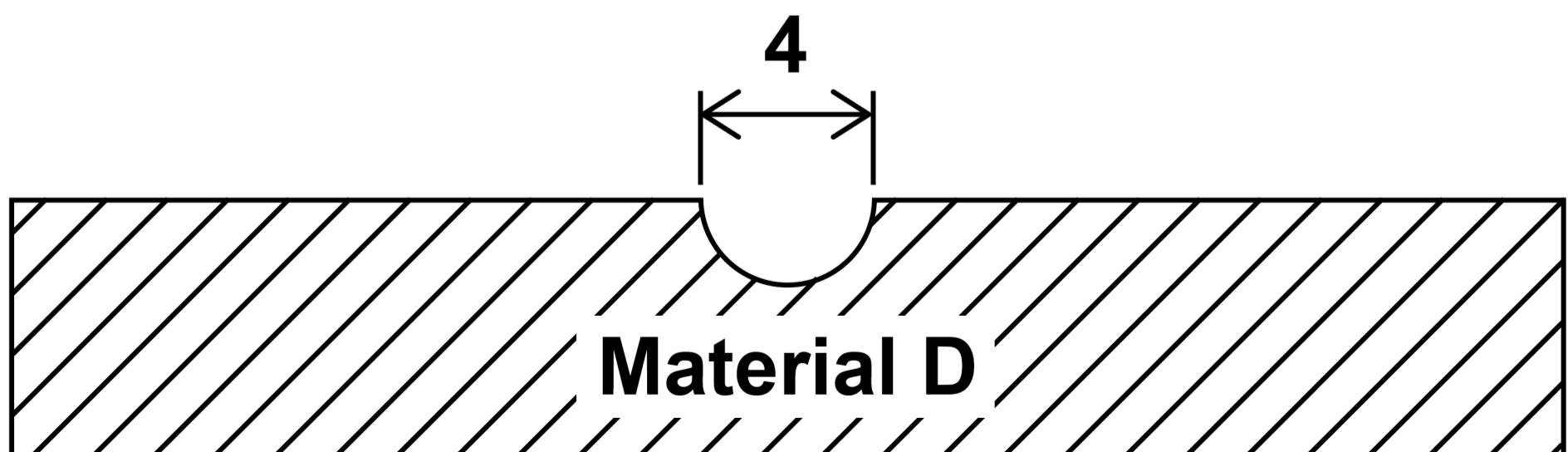
TABLE 1

TEST SAMPLE	Volume of indentation in mm^3
Material A	17.25
Material B	15.90
Material C	16.25
Material D	

Using the information in TABLE 1, complete the descending order of hardness in TABLE 2, on the opposite page.

TABLE 2

Test samples in descending order of hardness	
Material	
Material	
Material	
Material	

<div style="text-align: right; border: 1px solid black; display: inline-block;">3</div>

[Turn over]

| 1 | 2 |

Describe how the critical assessment of existing products can influence the work of designers and manufacturers.
[6 marks]

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[Turn over]

1	3

Explain why anodising is an appropriate finish for the aluminium torch shown in FIGURE 9. [6 marks]

FIGURE 9

12

1 4

Explain why EACH of the following finishing techniques have been used.
[3 × 2 marks]

FIGURE 10

Embossing _____

_____

_____

_____

_____

_____

FIGURE 11

Foil blocking _____

_____

_____

_____

_____

_____

FIGURE 12

The image is not reproduced here due to third party copyright restrictions.

Spot varnishing _____

_____

_____

_____

_____

[Turn over]

6

1 5

State TWO reasons why a low carbon steel component may be case hardened. [2 marks]

Reason 1 _____

_____

_____

Reason 2 _____

_____

_____

16.**1**

Identify the specific material classification of gold. [1 mark]

_____

_____

_____

16.**2**

Describe TWO PHYSICAL PROPERTIES of gold. [2 marks]

1 _____

_____

_____

2 _____

_____

_____

[Turn over]

17

Give THREE reasons why a gel coat is used when laminating a glass reinforced plastic (GRP) product. [3 marks]

Reason 1 _____

_____

_____

Reason 2 _____

_____

_____

Reason 3 _____

_____

_____

8

1 8

Analyse and evaluate the impact that 'open design' has had on traditional product development. [9 marks]

_____

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_____

[Turn over]

9

19.**1**

FIGURE 13, on page 48, shows the cross section of a tree trunk that is going to be sawn into planks as illustrated.

[Turn over]

FIGURE 13

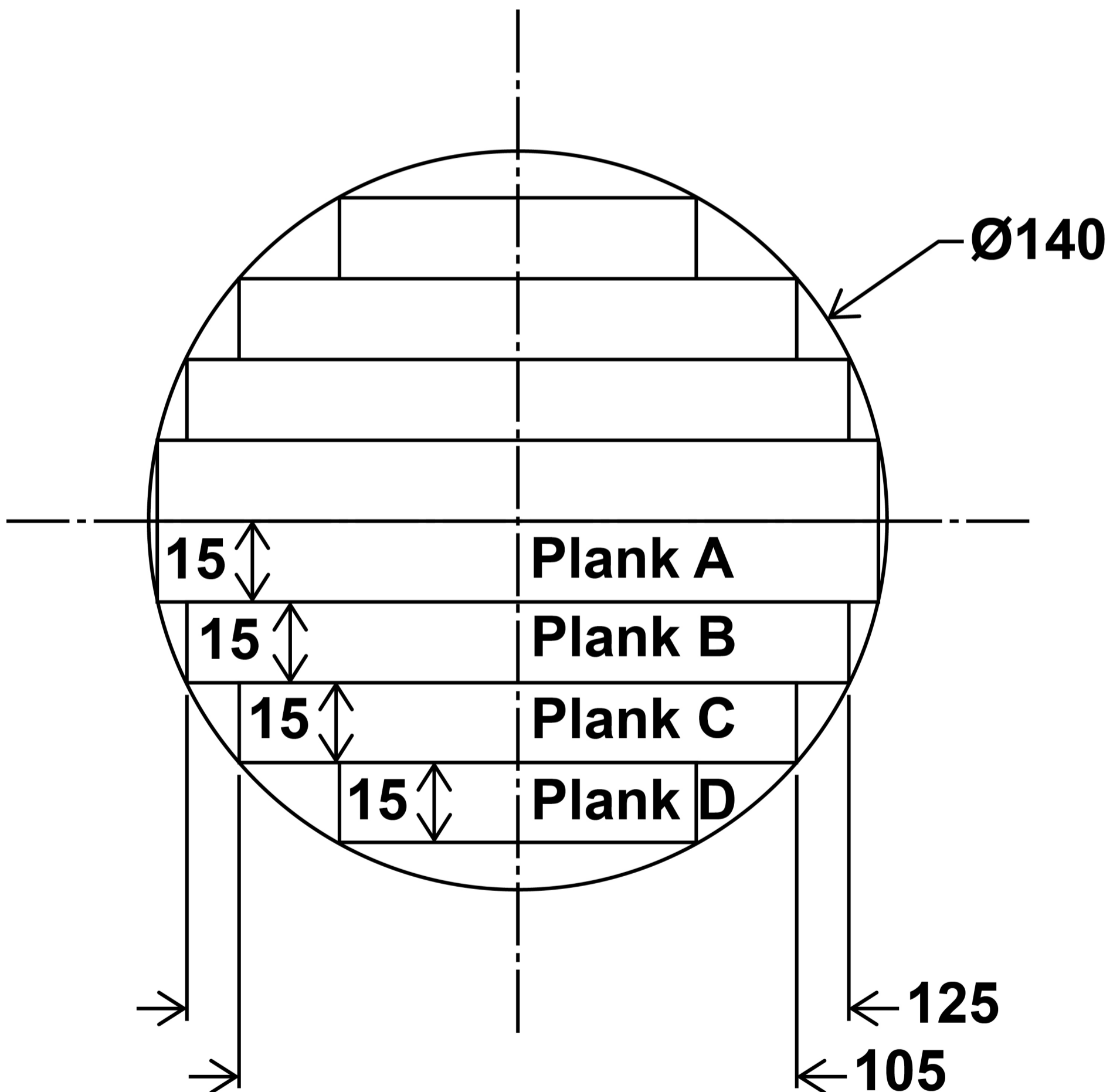**The diagram is not drawn to scale.**

All dimensions in mm

Ø140

15 — Plank A

15 — Plank B

15 — Plank C

15 — Plank D

125

105

Calculate the maximum width of Plank A and Plank D to the nearest 1 mm.

You MUST show your working out.
[3 marks]

Plank A _____

_____

_____

_____

Answer _____ mm

Plank D _____

_____

_____

_____

Answer _____ mm

[Turn over]

1 9 . 2

Calculate the percentage of timber that can be converted into planks from the tree trunk.

Show your working out. [4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

Answer _____ **%**

7

2 0

Explain why a manufacturer may choose to use a vertical in-house production system. [6 marks]

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_____

[Turn over]

2 1

Explain how a manufacturer of children's toys would ensure that their product is safe for the consumer. [6 marks]

_____

_____

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_____

[Turn over]

2 2

Name a specific application for EACH of the following composites:
[3 marks]

Reinforced concrete _____

_____

_____

Fibre cement _____

_____

_____

Carbon fibre reinforced plastic (CFRP)

_____

_____

_____

[Turn over]

9

2 3

Describe the stages required to produce a vacuum formed polymer product.
[6 marks]

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END OF QUESTIONS

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Write the question numbers in the left-hand margin.

Additional page, if required.
Write the question numbers in the left-hand margin.

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