A

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

At the top of the page, write your surname and forename(s), your centre number, your candidate number and add your signature.

[Turn over]

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MATERIALS

For this paper you must have:

- **normal writing and drawing instruments**
- **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

Answer ALL questions in the spaces provided.

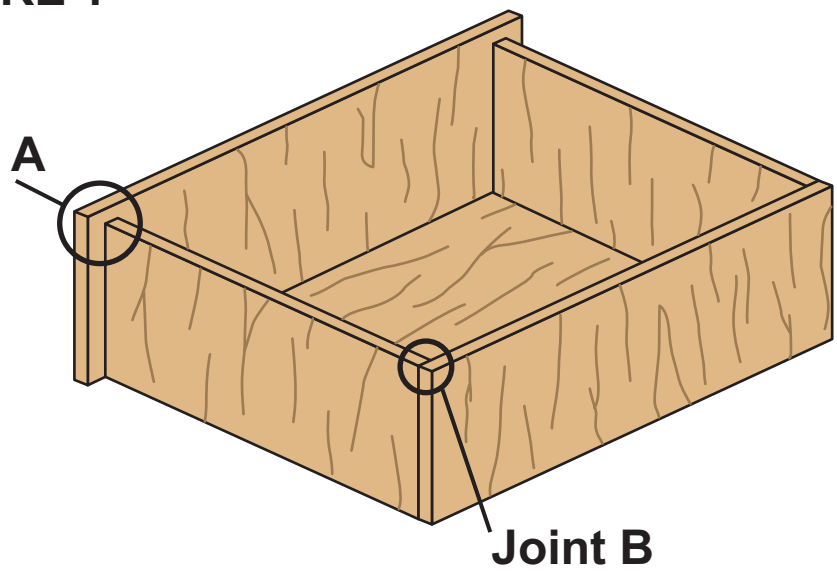
0 1

FIGURE 1 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 _____

_____

_____

2

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]

_____

_____

_____

3

[Turn over]

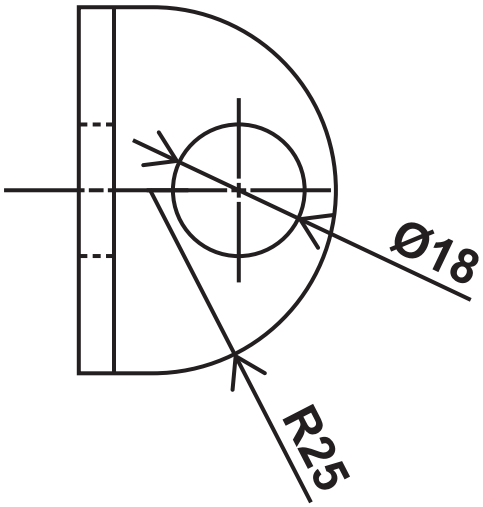
0 3

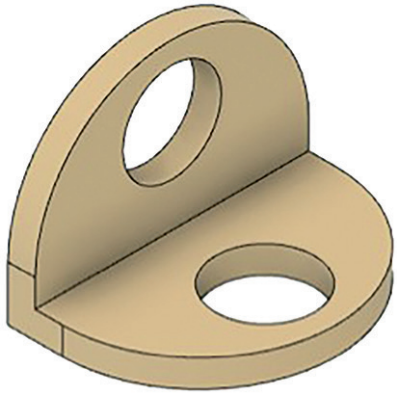
FIGURE 2, on page 7, shows a dimensioned orthographic drawing of a component.

Calculate the volume of the component. Show your working out. [4 marks]

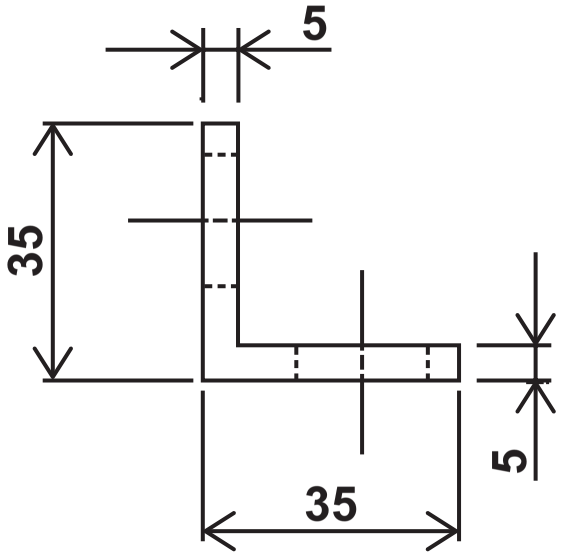
Answer _____ mm^3

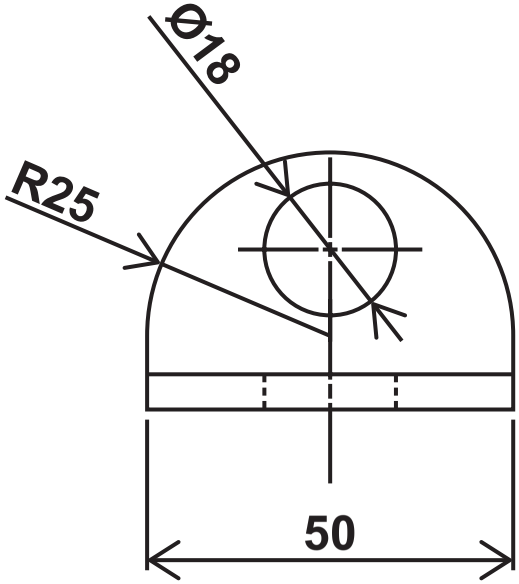
FIGURE 2

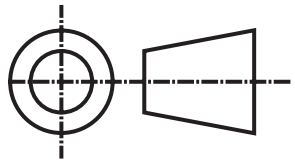




Component







Not drawn to scale. All dimensions in mm

4

[Turn over]

0 4

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

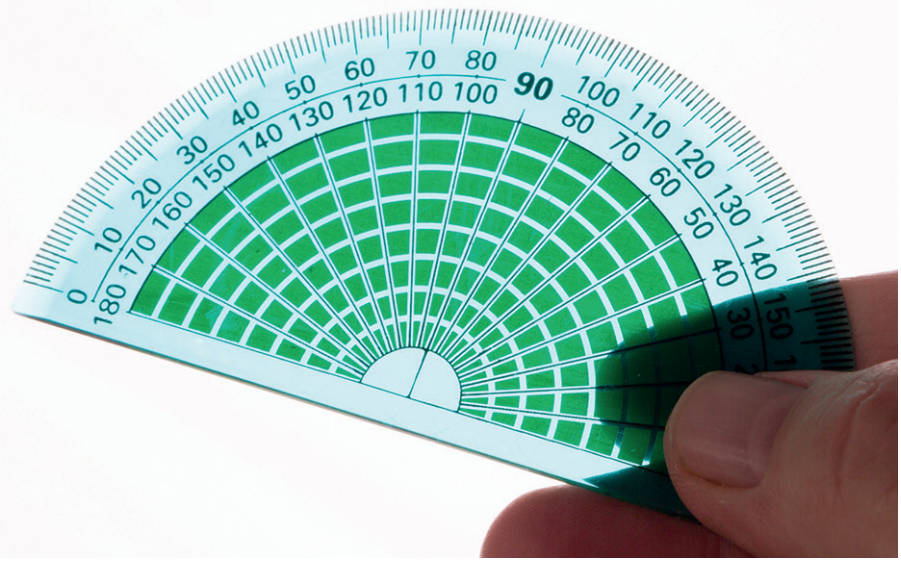
6

[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



6

[Turn over]

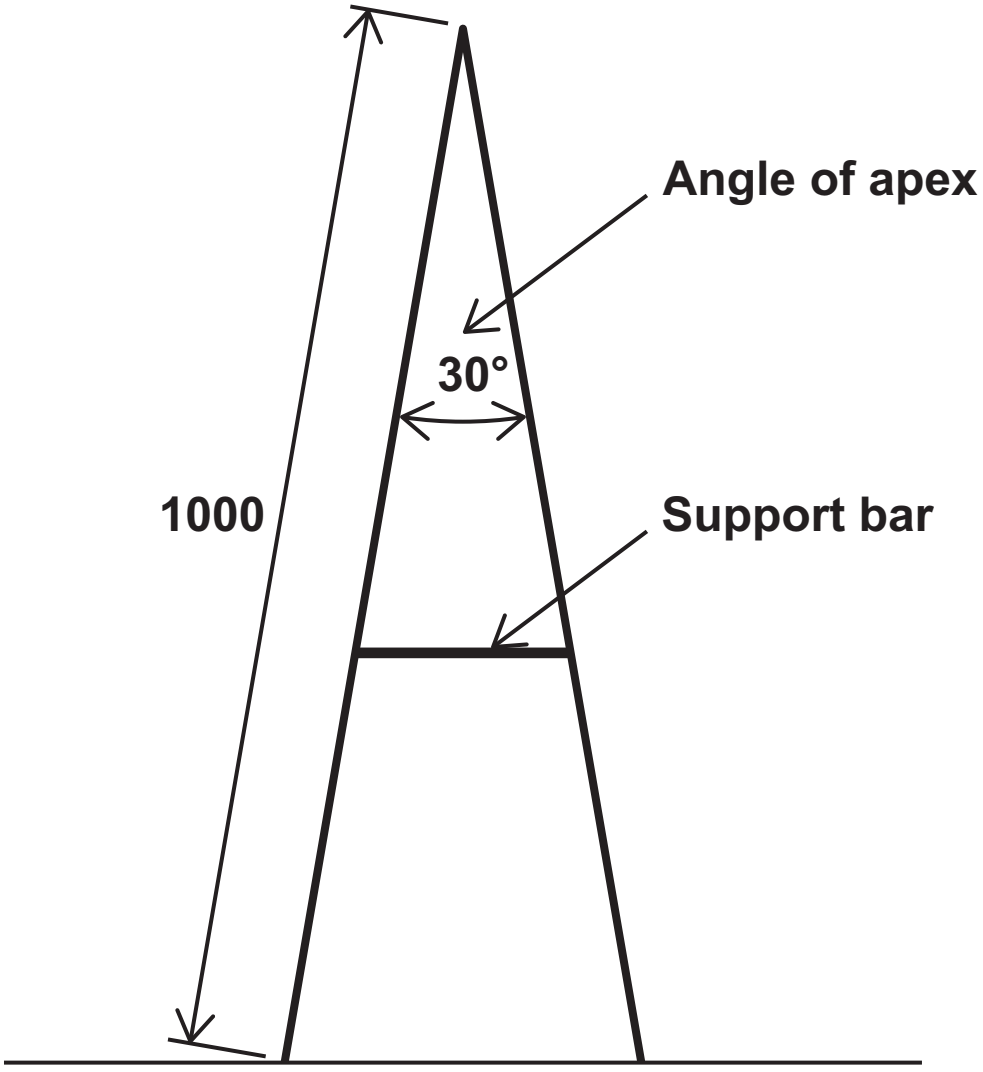
0 6 . 1

FIGURE 4 shows a side view representing a child's art easel.

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

FIGURE 4

Not drawn to scale
All dimensions in mm



Calculate the length of the support bar.

Show your working out. [2 marks]

_____

_____

_____

_____

_____

_____

Answer _____ mm

[Turn over]

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

6

[Turn over]

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]

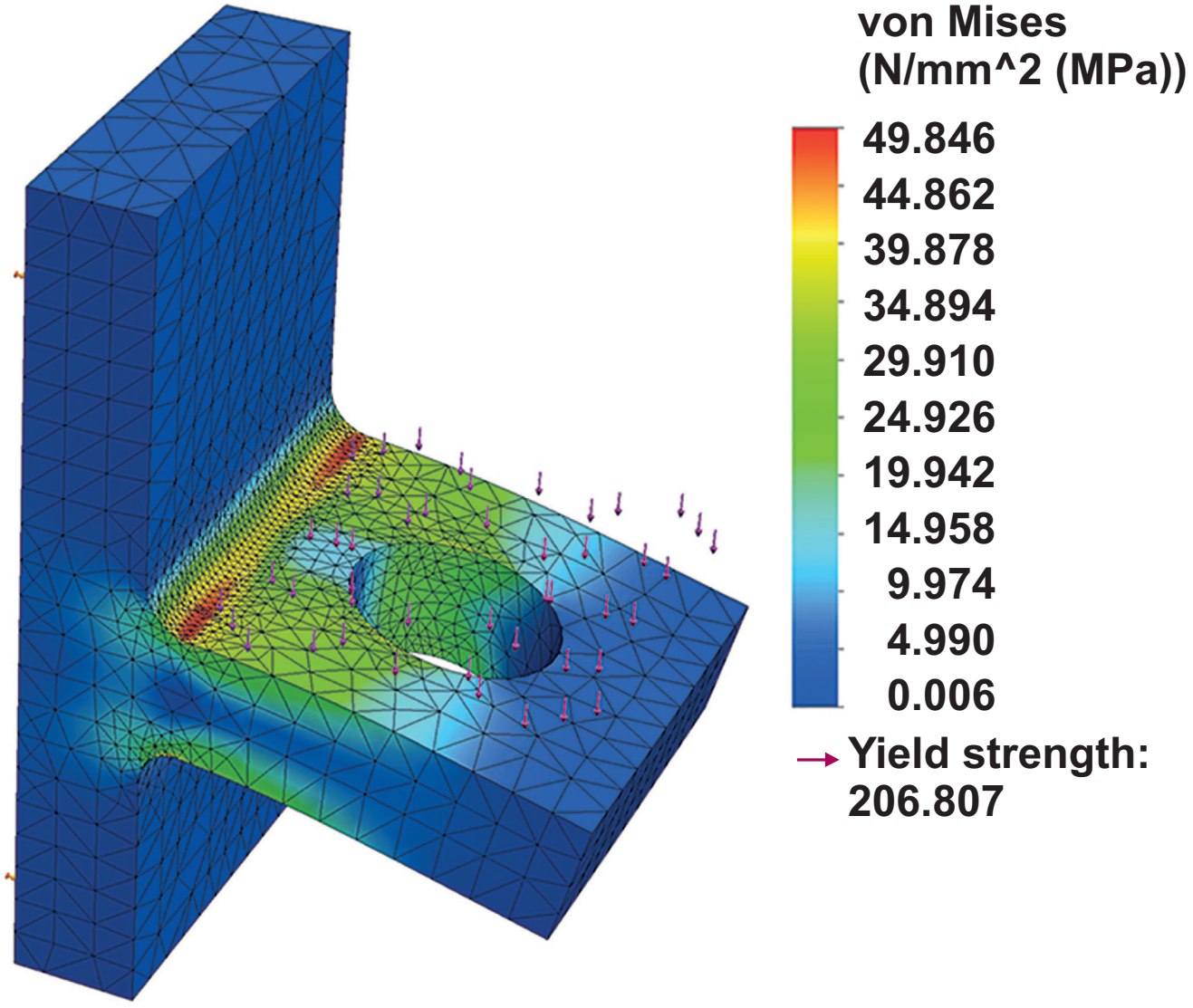
FIGURE 5

6

0 8

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

FIGURE 6



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

6

[Turn over]

0 9

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

9

[Turn over]

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

[Turn over]

1 1

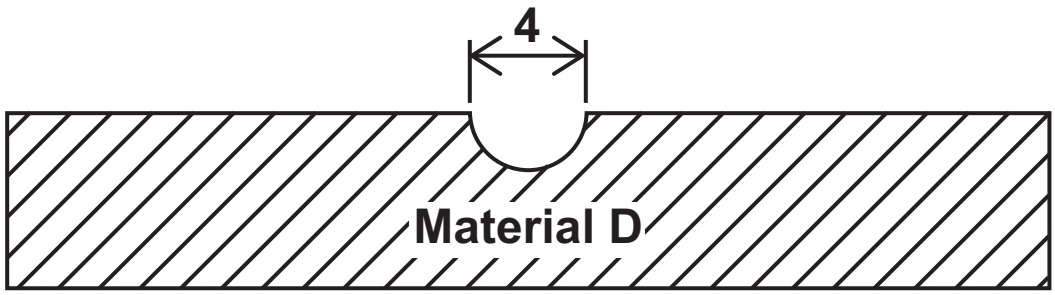
FIGURE 8 shows the cross section of a piece of material that has been subjected to a hardness test.

TABLE 1, on page 26, 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



Not drawn to scale
All dimensions in mm

Calculate the volume of the indentation and complete TABLE 1.

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

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.

TABLE 2

Test samples in descending order of hardness	
Material	
Material	
Material	
Material	

3

BLANK PAGE

[Turn over]

1 2

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

6

[Turn over]

1 3

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

FIGURE 9

6

[Turn over]

1 4

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

FIGURE 10

Embossing _____

_____

_____

_____

_____

_____

FIGURE 11

Foil blocking _____

_____

_____

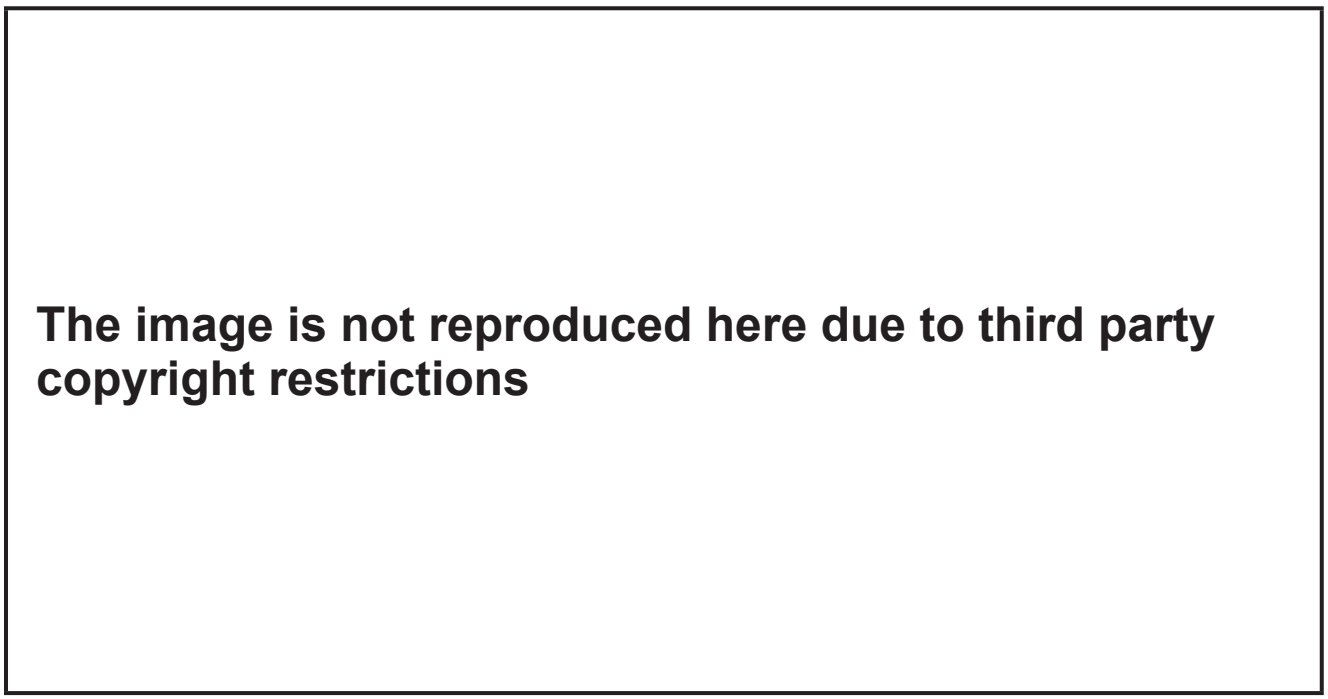
_____

_____

_____

[Turn over]

FIGURE 12



Spot varnishing _____

_____

_____

_____

_____

_____

6

1 5

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

Reason 1 _____

_____

_____

Reason 2 _____

_____

_____

2

[Turn over]

1 6 . 1

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

_____

_____

_____

1 6 . 2

Describe TWO PHYSICAL PROPERTIES of gold.
[2 marks]

1 _____

_____

_____

2 _____

_____

_____

3

1 7

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 _____

_____

_____

3

[Turn over]

1 8

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

9

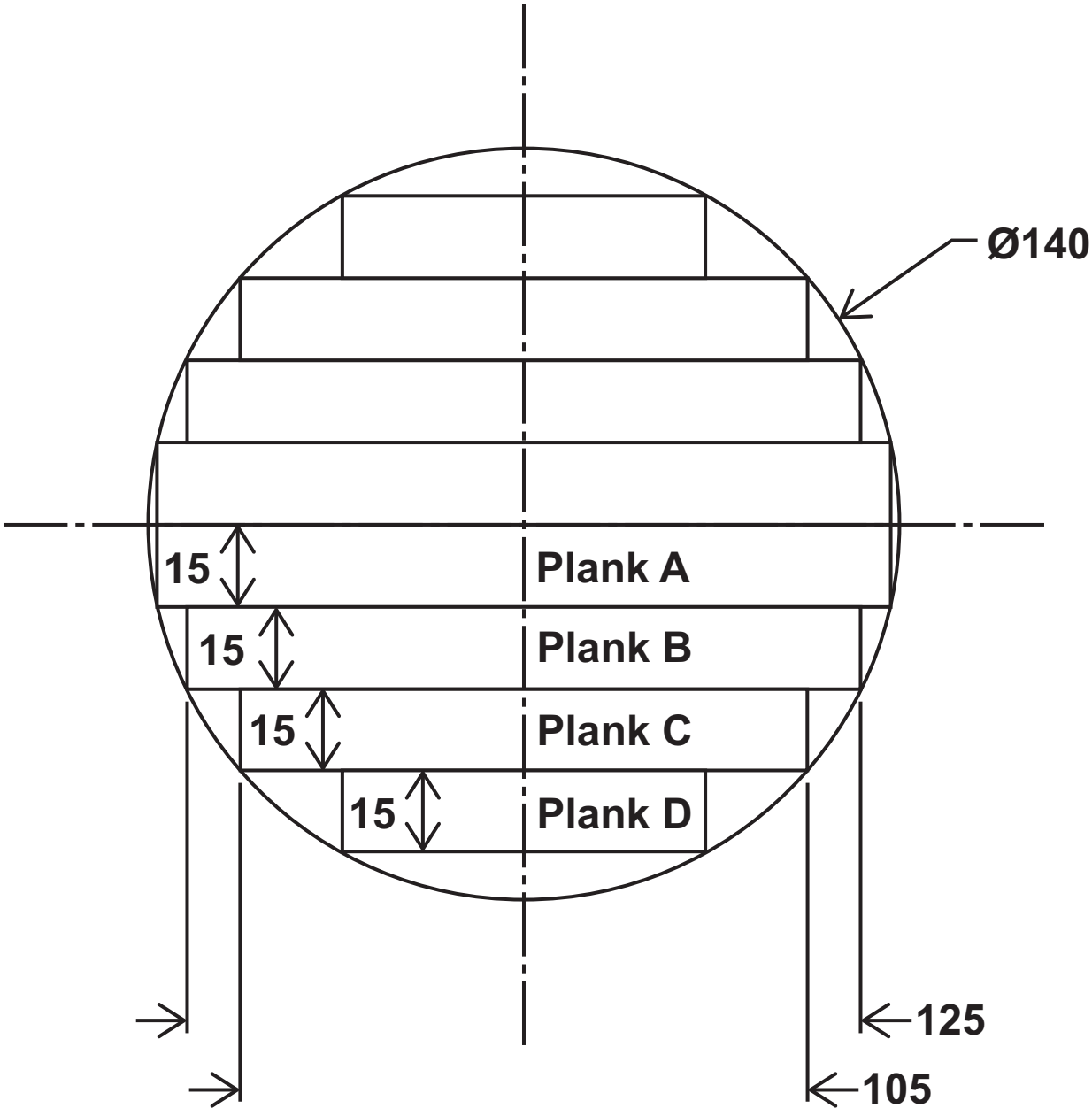
[Turn over]

1 9 . 1

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

FIGURE 13

Not drawn to scale
All dimensions in mm



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]

19.2

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]

6

BLANK PAGE

[Turn over]

2 1

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

2 2

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

Reinforced concrete _____

Fibre cement _____

Carbon fibre reinforced plastic (CFRP) _____

9

2 3

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

6

END OF QUESTIONS

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

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

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For Examiner's Use	
Question	Mark
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