

Please write clearly in block capitals.

Centre number

--	--	--	--	--

Candidate number

--	--	--	--

Surname

Forename(s)

Candidate signature

I declare this is my own work.

A-level

DESIGN AND TECHNOLOGY:

PRODUCT DESIGN

Paper 1 Technical Principles

Wednesday 7 June 2023

Afternoon

Time allowed: 2 hours 30 minutes

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.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or 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.

For Examiner's Use	
Question	Mark
1–2	
3	
4–5	
6	
7–8	
9	
10	
11	
12–13	
14	
15–17	
18	
19	
20	
21–22	
23	
TOTAL	



J U N 2 3 7 5 5 2 1 0 1

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

0 1

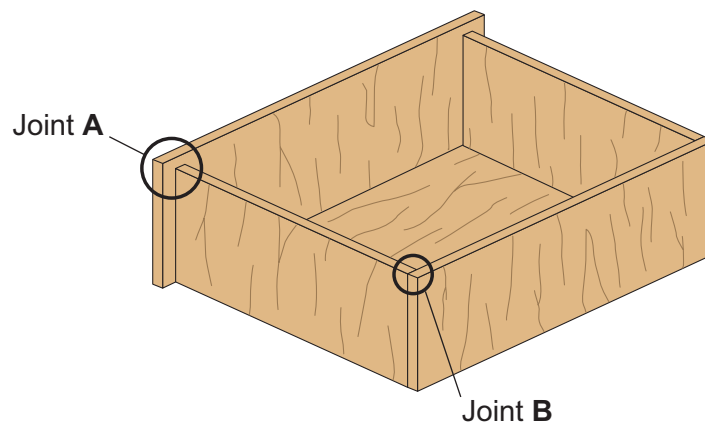
Figure 1 shows a labelled diagram of a hardwood drawer.

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** _____

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.

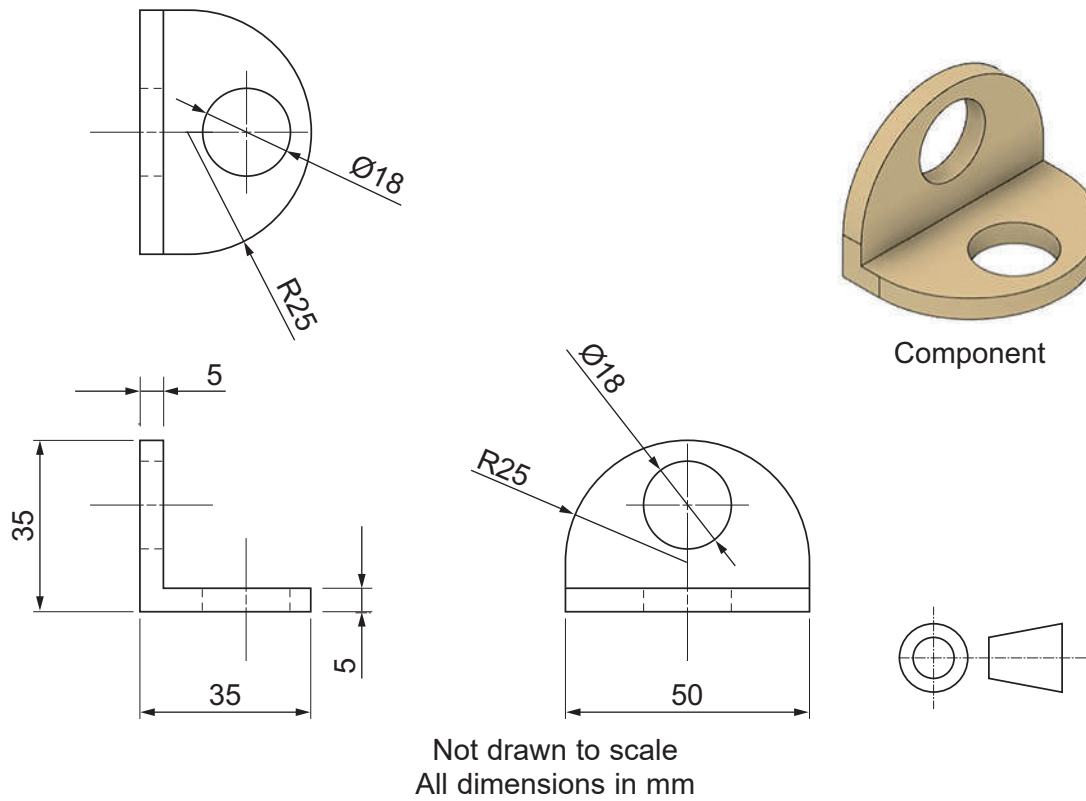
[1 mark]



0 3

Figure 2 shows a dimensioned orthographic drawing of a component.

Figure 2



Calculate the volume of the component.

Show your working out.

[4 marks]

Answer _____ mm³

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.

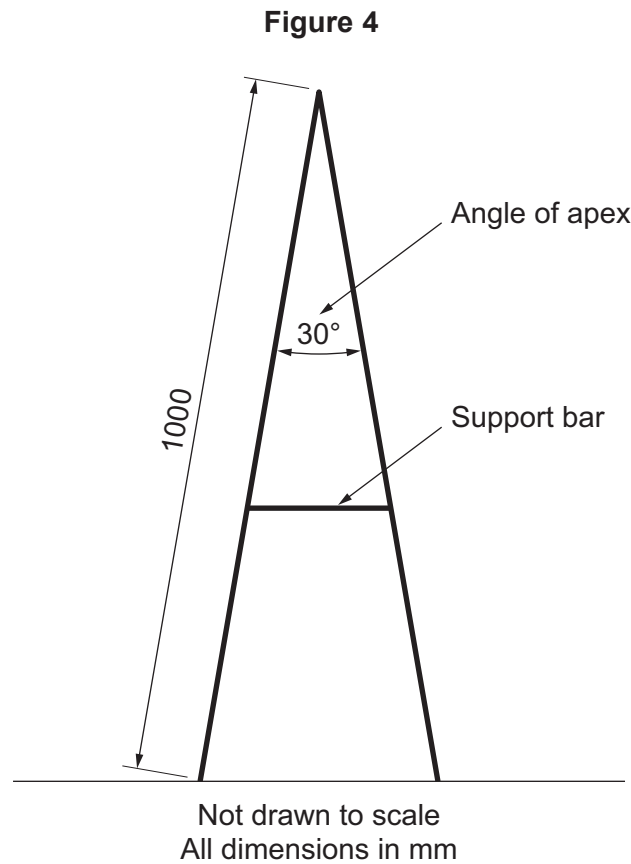
[6 marks]



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.



Calculate the length of the support bar.

Show your working out.

[2 marks]

Answer _____ mm



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 for the next question

Turn over ►



Analyse and evaluate the suitability of rotational moulding for the manufacture of the child's art easel shown in **Figure 5**.

Figure 5

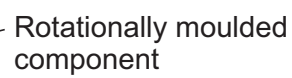
[illegible]

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

von Mises (N/mm² (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

[6 marks]

[illegible]

12

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

[illegible]

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

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

6

Turn over ►



1 1

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

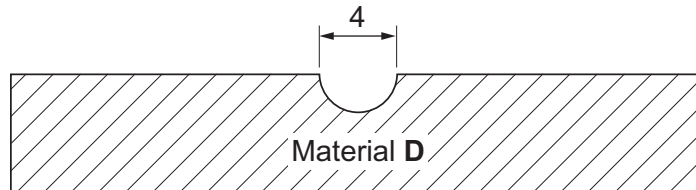
Table 1 shows the results of three other materials that have also been tested.

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 _____ mm³



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

Turn over for the next question

Turn over ►



Describe how the critical assessment of existing products can influence the work of designers and manufacturers.

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.



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 _____



1 5

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

Reason 1 _____

Reason 2 _____

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 _____

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 _____

8

Turn over for the next question**Turn over ►**

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

[illegible]

Turn over for the next question

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

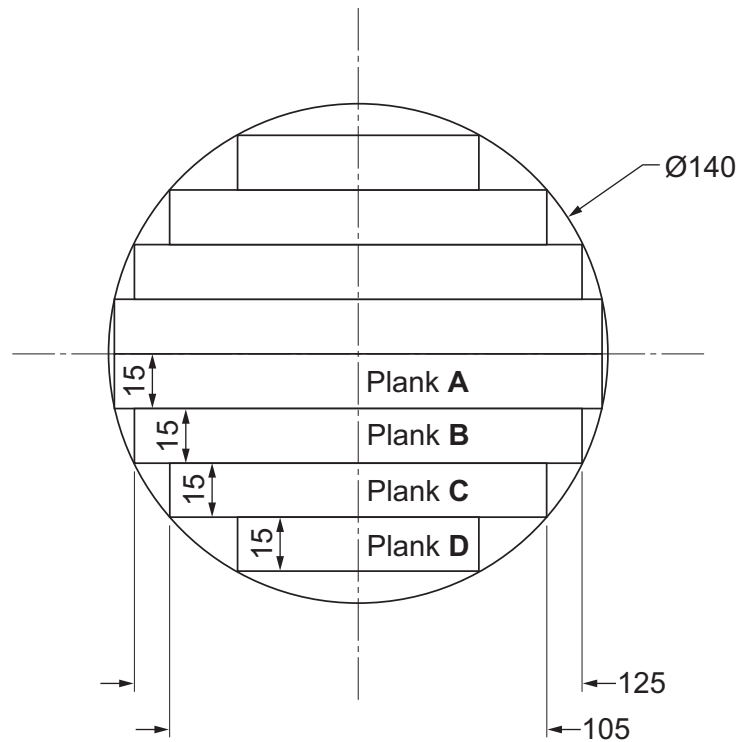
Turn over ►



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



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

Turn over for the next question

Turn over ►



2	0
---	---

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

6



[6 marks]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

[3 marks]

9

Describe the stages required to produce a vacuum formed polymer product.

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

6

END OF QUESTIONS



There are no questions printed on this page

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**



[illegible]

[illegible]

[illegible]