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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		
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12–13		
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23		
TOTAL		



Answer all questions in the spaces provided.

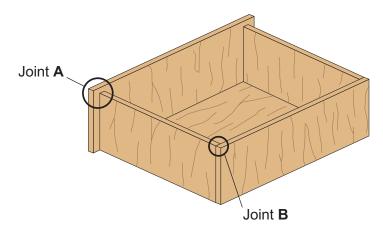
0 1 Figure 1 shows a labelled diagram of a hardwood drawer.

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 Component R25 35 2 50 35 Not drawn to scale All dimensions in mm Calculate the volume of the component. Show your working out. [4 marks] _ mm³ Answer _____



4	Compare and evaluate the suitability of Acrylonitrile Butadiene Styrene (A Polylactic Acid (PLA) for the manufacture of a 3D printed component.	(BS) and
		to marks

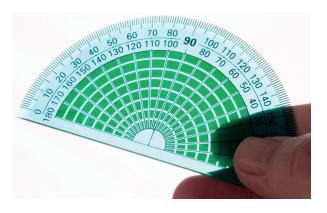


0 5

Explain why High Impact Polystyrene (HIPS) is an appropriate material for the manufacture of the protractor shown in **Figure 3**.

[6 marks]

Figure 3



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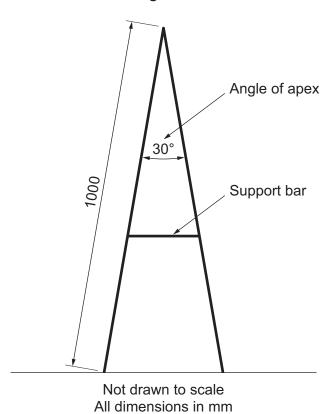
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0 6 . 1 Figure 4 shows a side view representing a child's art easel.

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

Figure 4



Calculate the length of the support bar.

Show your working out.

Answer	mm



[2 marks]

0 6 . 2	Consumers have raised issues with the stability of the easel and the manhas decided to increase the length of the support bar to 400 mm.	ufacturer o
	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 for the next question



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

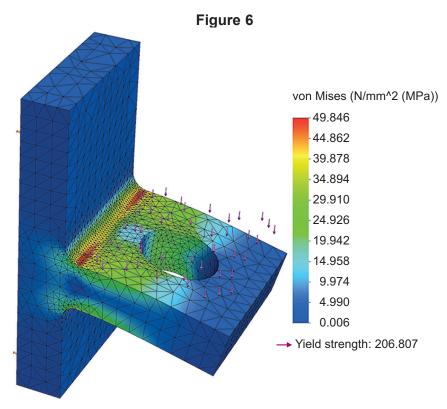


Rotationally moulded component



0 8

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



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]

. .



as part of the ongoing maintenance of electronic products.	[9 marks



1 0 Explain why teak is an appropriate material for the manufacture of the sun lounger shown in **Figure 7**.

[6 marks]







Figure 8 shows the cross section of a piece of material that has been subjected 1 1 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 Material **D** 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 [.]
Aliswei	111111

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		

Turn over for the next question





(Describe how the critical assessment of existing products can influence the work of designers and manufacturers.
	[6 mark
_	
-	
_	
_	
-	
_	



1 3

Explain why anodising is an appropriate finish for the aluminium torch shown in **Figure 9**.

[6 marks]

Figure 9



· · · · · · · · · · · · · · · · · · ·	·	·	
· · · · · · · · · · · · · · · · · · ·		·	

Turn over ▶



1 4 Explain why **each** of the following finishing techniques have been used.

 $[3 \times 2 \text{ marks}]$

Figure 10



Embossing	 	 	

Figure 11



Figure 12

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Spot varnishing	 		



1 5	State two reasons why a low carbon steel component may be case hardened. [2 marks]	OL
	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]	
	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	

Turn over for the next question



1 8	Analyse and evaluate the impact that 'open design' has had on traditional product development.		
		[9 marks]	

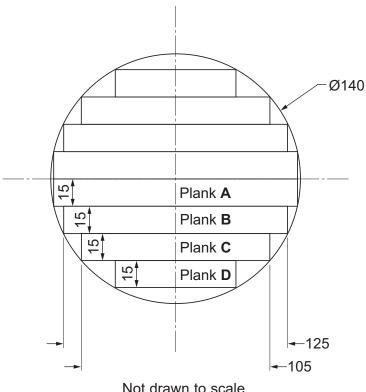


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1 9 • 1 Figure 13 shows the cross section of a tree trunk that is going to be sawn into planks as illustrated.





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.

[ၖ	ma	arks
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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 %	
	Turn over for the next question	
	Answer %	



	•	a manufacturer may o	·	[6 r

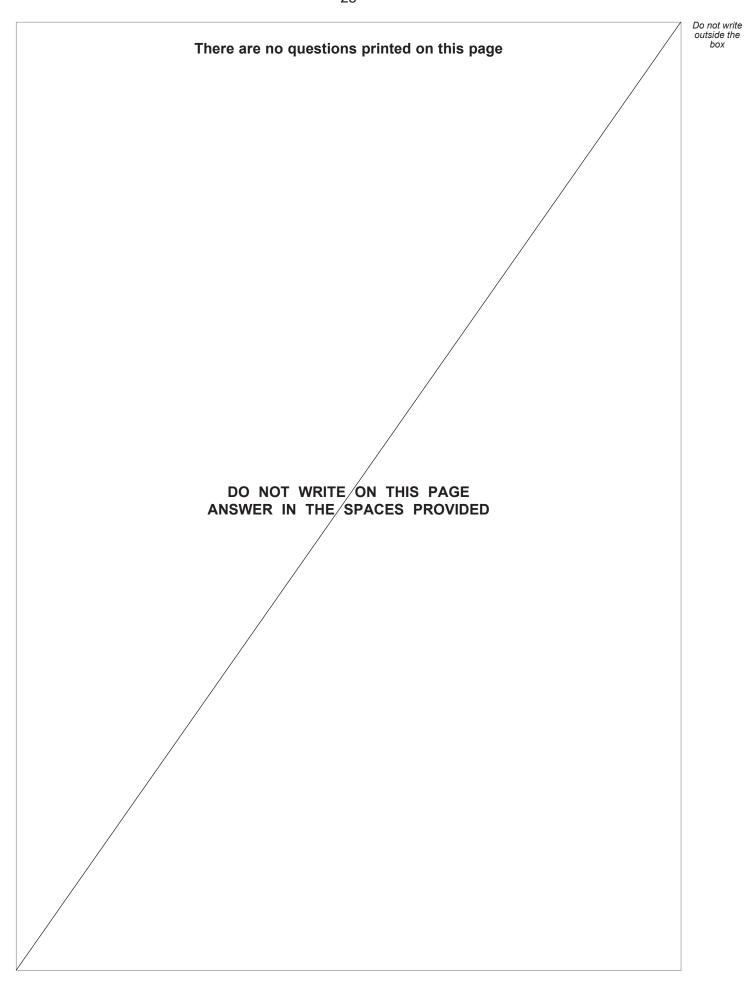


	for the consumer.	product is safe
		[6 marks
2	Name a specific application for each of the following composites:	[3 marks
		-
	Reinforced concrete	
	Fibre cement	
	Carbon fibre reinforced plastic (CFRP)	



2 3	Describe the stages required to produce a vacuum formed polymer product. [6 marks]
	END OF QUESTIONS







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