AQA

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

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	
16	
17	
18	
19–20	
21–22	
TOTAL	

Do not write outside the box

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

0 1 State **three** reasons why Precious Metal Clay (PMC) may be used in the manufacture of a decorative pendant for a necklace.

[3 marks]

Reason 1 _____

_____

Reason 2 _____

_____

Reason 3 _____

_____

0 2 A purple component is to be produced using a pigmented resin.

Use the data to calculate the maximum number of these components that could be produced.

You may assume unlimited supplies of clear resin and magenta pigment.

[4 marks]

Cyan pigment available	10 ml
Single component volume	5965 mm^3

	Clear Resin	**Cyan Pigment**	**Magenta Pigment**
Ratios for Purple Resin	80	4	1

_____

_____

_____

_____

_____

_____

_____

Answer _____ components

7

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0 3 **Figure 1** shows a low carbon steel shopping basket with a chrome plated finish.

Figure 1

Analyse and evaluate the suitability of the material and finish used for the shopping basket.

[6 marks]

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0 4 Explain how rapid prototyping has impacted on traditional manufacture.

[9 marks]

15

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

0 5 . 1 **Table 1** shows a series of coordinates used by a laser cutter to produce a component.

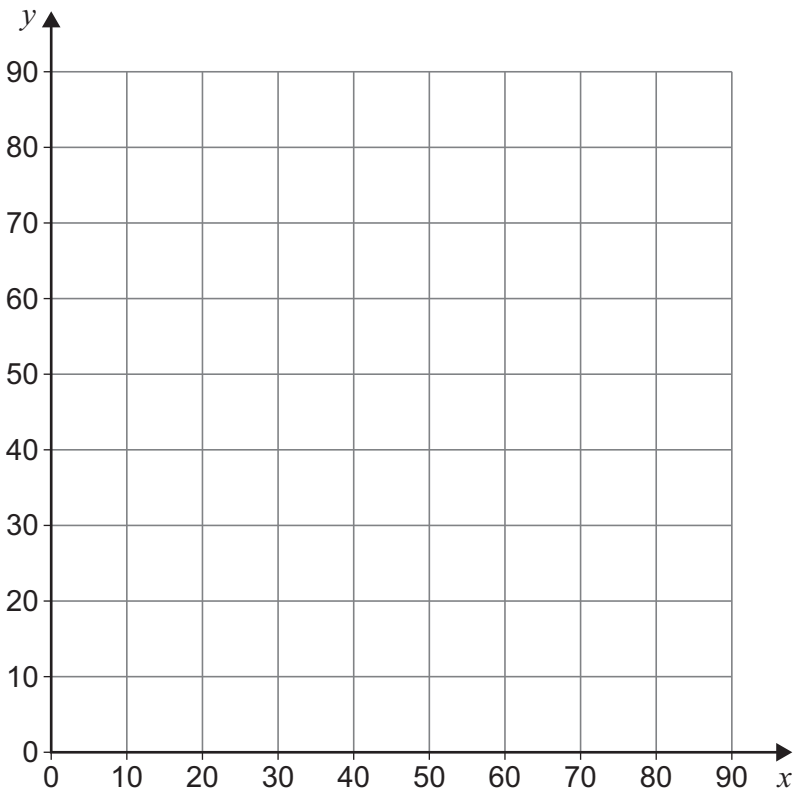
The external and internal cutting paths are shown.

Table 1

External Path	Internal Path
(10,10)	(30,20)
(70,10)	(60,20)
(70,80)	(60,70)
(30,80)	(40,70)
(10,10)	(30,20)

Plot the external and internal paths on the grid below.

[1 mark]



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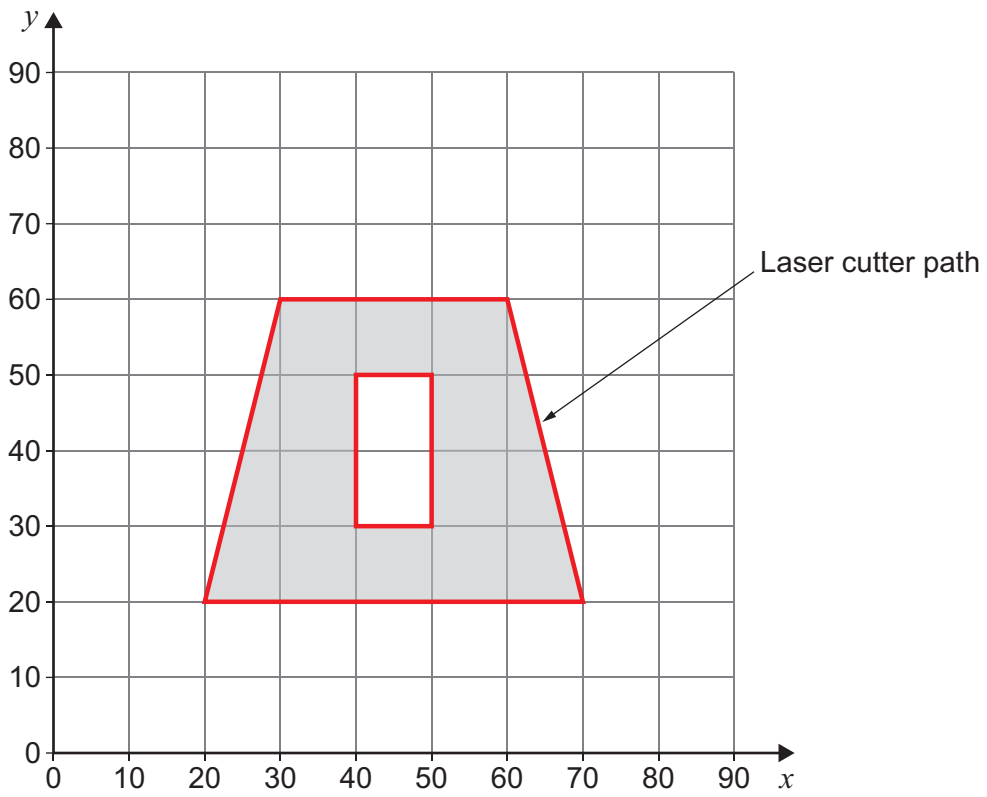
0 5 . 2 **Figure 2** shows the path of a laser cutter used to cut the shape below.

Figure 2



Grid spacing in mm

Calculate the shaded area.

[2 marks]

Total shaded area _____ mm^2

3

Turn over ▶

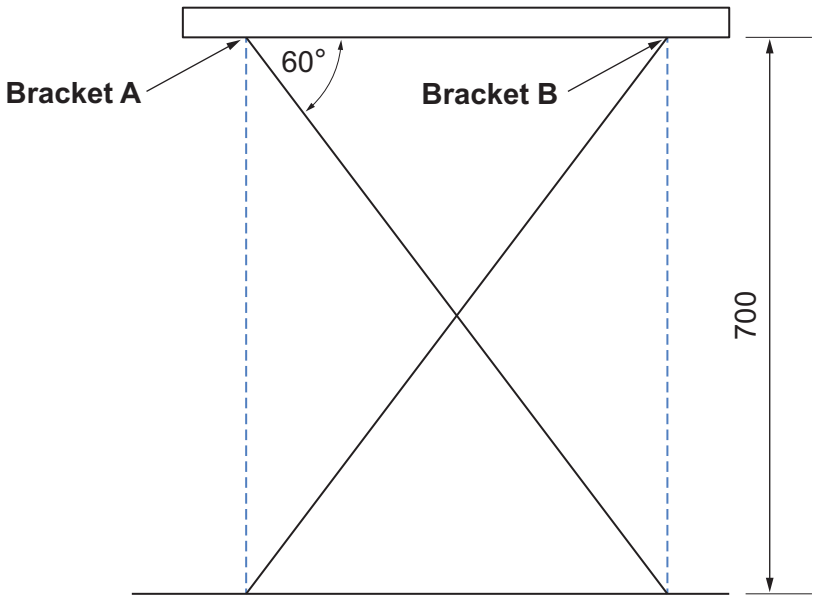
0 6 **Figure 3** shows the current dimensions of a school desk.

If all existing components are used, calculate how much closer together **Bracket A** and **Bracket B** would be at a new desk height of 720 mm.

Assume that when fully extended the end of each leg is vertically in line with the bracket on the underside of the desk.

[7 marks]

Figure 3



Not drawn to scale
Dimension in mm

Do not write outside the box

Distance between **Bracket A** and **Bracket B** is closer by =

_____ mm

7

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0 7 Explain why galvanising is an appropriate finish for the low carbon steel scaffold shown in **Figure 4**.

[6 marks]

Figure 4

6

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0 8 State **three** different stimuli that can cause a change in the property of a smart material.

[3 marks]

Stimulus 1 _____

_____

Stimulus 2 _____

_____

Stimulus 3 _____

_____

0 9 Name a specific application for each of the following materials:

[3 marks]

Cellulose acetate _____

_____

Fluted polypropylene _____

_____

Styrofoam _____

_____

6

Turn over for the next question

Do not write outside the box

1 0 Styrofoam and high-density modelling foam are often used in modelling.

Compare and evaluate the suitability of each material for the manufacture of a block model that represents aesthetic appearance to a potential client.

[6 marks]

Do not write outside the box

1 1 Explain why die casting is an appropriate manufacturing method for the model toy vehicle shown in **Figure 5**.

[6 marks]

Figure 5

12

Do not write outside the box

1 2 Describe the purpose of the following polymer additives:

- fillers
- plasticisers.

[2 x 2 marks]

Fillers _____

_____

_____

_____

Plasticisers _____

_____

_____

_____

1 3 Give **two** reasons why outdoor decking may be pressure treated before use.

[2 marks]

1 _____

_____

2 _____

_____

6

Do not write outside the box

1 4 A polymer extrusion process has been used to produce the rigid polyvinyl chloride (PVC) cable trunking shown in **Figure 6**.

Describe the main stages of the polymer extrusion process.

[6 marks]

Figure 6

Do not write outside the box

1 5 Describe the advantages to a manufacturer of using bought-in components.

[6 marks]

12

Do not write outside the box

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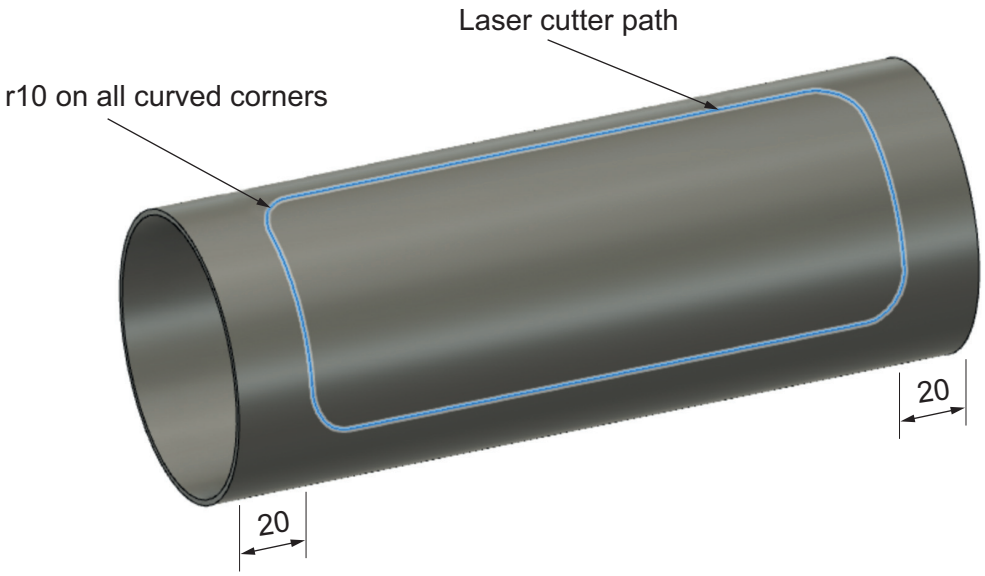
1 6 **Figure 7** shows an acrylic tube that will have a section cut out on a laser cutter.

The section to be removed is **one quarter** of the circumference of the tube.

Figure 7



All dimensions in mm

Length of Cylinder	200 mm
Diameter of Cylinder	75 mm
Cutting Speed	2200 mm per minute

Use the data provided to calculate the time taken to cut the path shown on the acrylic tube.

[6 marks]

Do not write outside the box

Total time taken in seconds _____

6

Turn over for the next question

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1 7 **Figure 8** and **Figure 9** show two novelty moneyboxes, each with a slot for coins located at the top.

Figure 8

Blow moulded, low density polyethylene (LDPE) moneybox

Figure 9

Injection moulded, polymethylmethacrylate (PMMA) moneybox

Analyse and evaluate the suitability of the materials and manufacturing methods used for each of the moneyboxes shown.

[12 marks]

Do not write outside the box

12

Do not write outside the box

1 8 Describe and explain the stages that timber undergoes from felling through to the creation of the planed square edge (PSE) stock form.

[6 marks]

6

Do not write outside the box

1 9 Describe **two** ways that a jig can be used to improve accuracy in manufacture.

[2 x 2 marks]

1 _____

_____

_____

_____

2 _____

_____

_____

_____

Turn over for the next question

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2 0 Justify why Finite Element Analysis (FEA) may be used to improve efficiency during product development.

[6 marks]

10

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2 1 Explain why tungsten carbide is an appropriate material for the manufacture of a centre lathe cutting tool.

[6 marks]

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2 2 Outline how and why a company would use social media to market their product.

[6 marks]

12

END OF QUESTIONS

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