

C600U10-1

TUESDAY, 18 JUNE 2024 – MORNING

DESIGN AND TECHNOLOGY

Component 1

**DESIGN AND TECHNOLOGY IN THE
21st CENTURY**

2 hours plus your additional time allowance

Surname _____

First name(s) _____

Centre Number _____

Candidate Number 0 _____

ADDITIONAL MATERIALS

You will need basic drawing equipment, coloured pencils and a calculator for this examination.

INSTRUCTIONS TO CANDIDATES

Use black ink, black ball-point pen or your usual method.

Write your name, centre number and candidate number in the spaces provided on the front cover.

Answer questions 1 to 5 and any ONE question 6.

Write your answers in the spaces provided in this booklet.

If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

(Turn over)

Section A	For Examiner's use only		
	Question	Maximum Mark	Mark Awarded
	1.	10	
	2.	10	
	3.	15	
	4.	20	
Section B	5.	20	
	6.	25	
	Total	100	

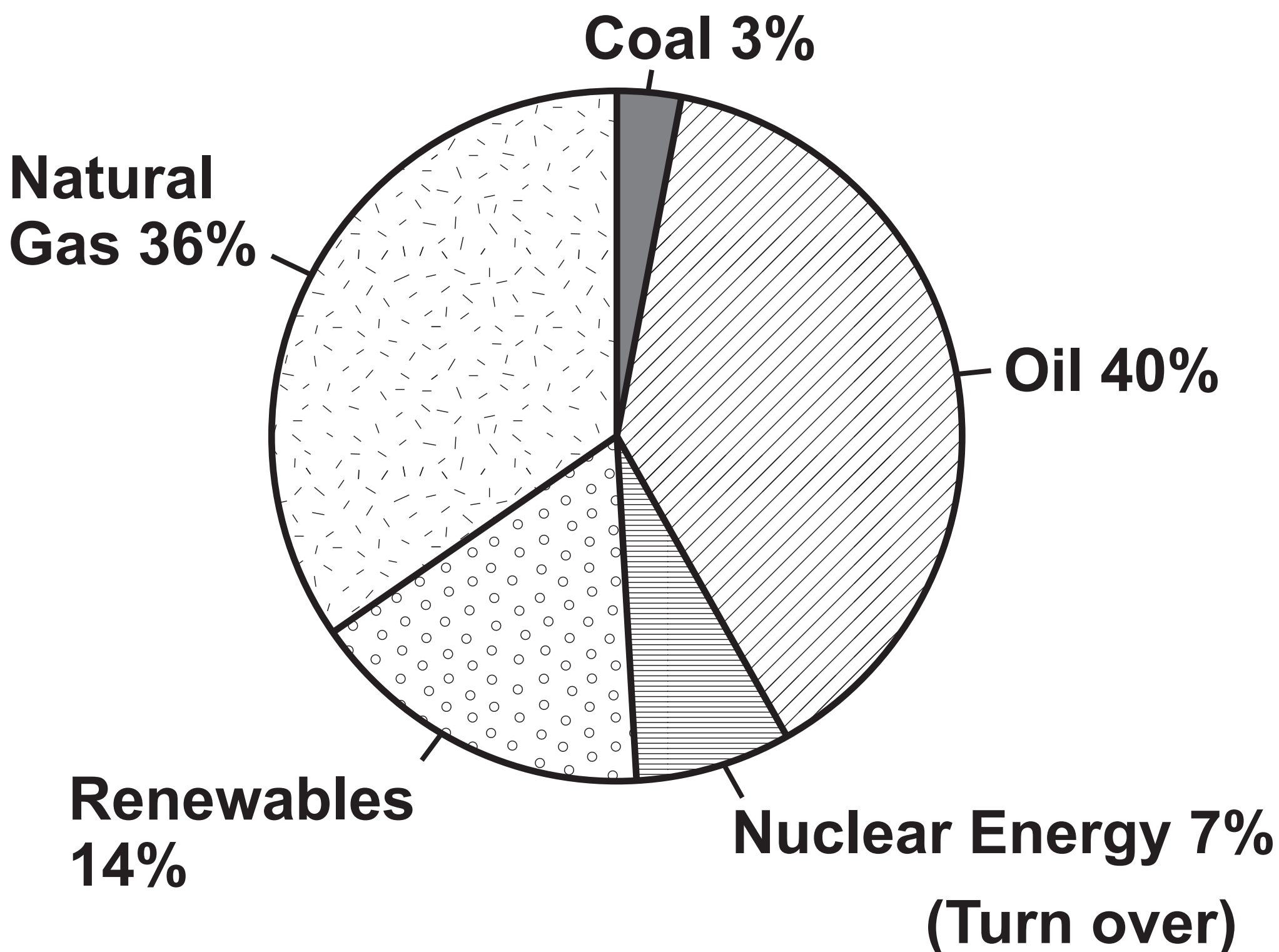
SECTION A

Answer ALL questions

This question is about Design and Technology and our world.

1 (a) The pie chart below shows the United Kingdom's (UK's) energy consumption by fuel type.

UK ENERGY CONSUMPTION BY FUEL TYPE



1 (a)(i)

**State the least consumed fuel type.
[1 mark]**

**(ii) Calculate the total percentage of
non-renewable energy sources
consumed.
Show all workings. [3 marks]**

(Turn over)

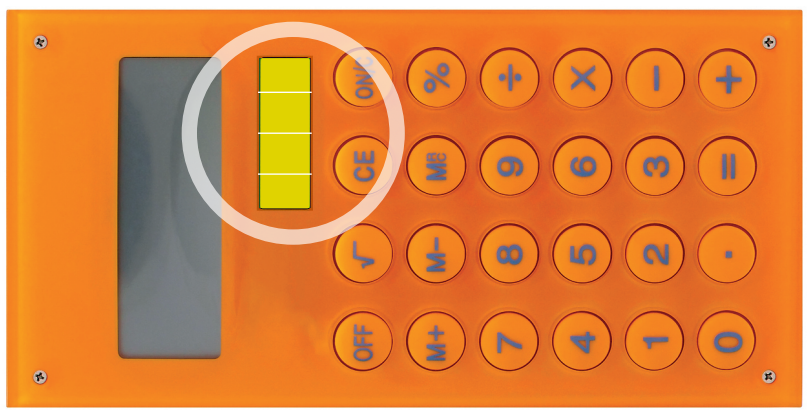
1 (a)(iii)

Give ONE reason why the UK needs to decrease its use of oil as an energy source. [1 mark]

(Turn over)

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TURN OVER



1 (b) The products shown on the opposite page use photovoltaic (PV) cells to function.

(i) Describe how the photovoltaic cells works. [2 marks]

(Turn over)

1 (b)(ii)

Explain why products with small photovoltaic cells have not been popular with consumers. [3 marks]

(Turn over)

This question is about materials technology.

2 (a) The products below are made with a breathable and waterproof membrane material.



**(i) State ONE reason why these products need to be breathable.
[1 mark]**

(Turn over)

2 (a)(ii)

In the space below, draw and label a diagram that shows how the breathable and waterproof membrane material functions. [4 marks]

(Turn over)

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TURN OVER

STATEMENT	TRUE	FALSE
Geotextiles can be woven.		
Geotextiles can be made from synthetic and natural materials.		

2 (b) The picture below shows a geotextiles material used for outdoor building construction and maintenance.



(i) Put a tick (✓) in the table on the opposite page to indicate whether the following statements are true or false. 2 × [1 mark]

(Turn over)

2 (b)(ii)

Discuss how geotextiles are benefiting the outdoor and construction industry. [3 marks]

continue answer on next page (Turn over)

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TURN OVER



Record

Turntable

This question is about electronic systems, programmable components and mechanical devices.

3 (a) The image on the opposite page is of a modern record player.

(i) State the type of motion the record will take when being played. [1 mark]

(ii) State the meaning of rpm. [1 mark]

R _____

P _____

M _____

(Turn over)

3 (a)(iii)

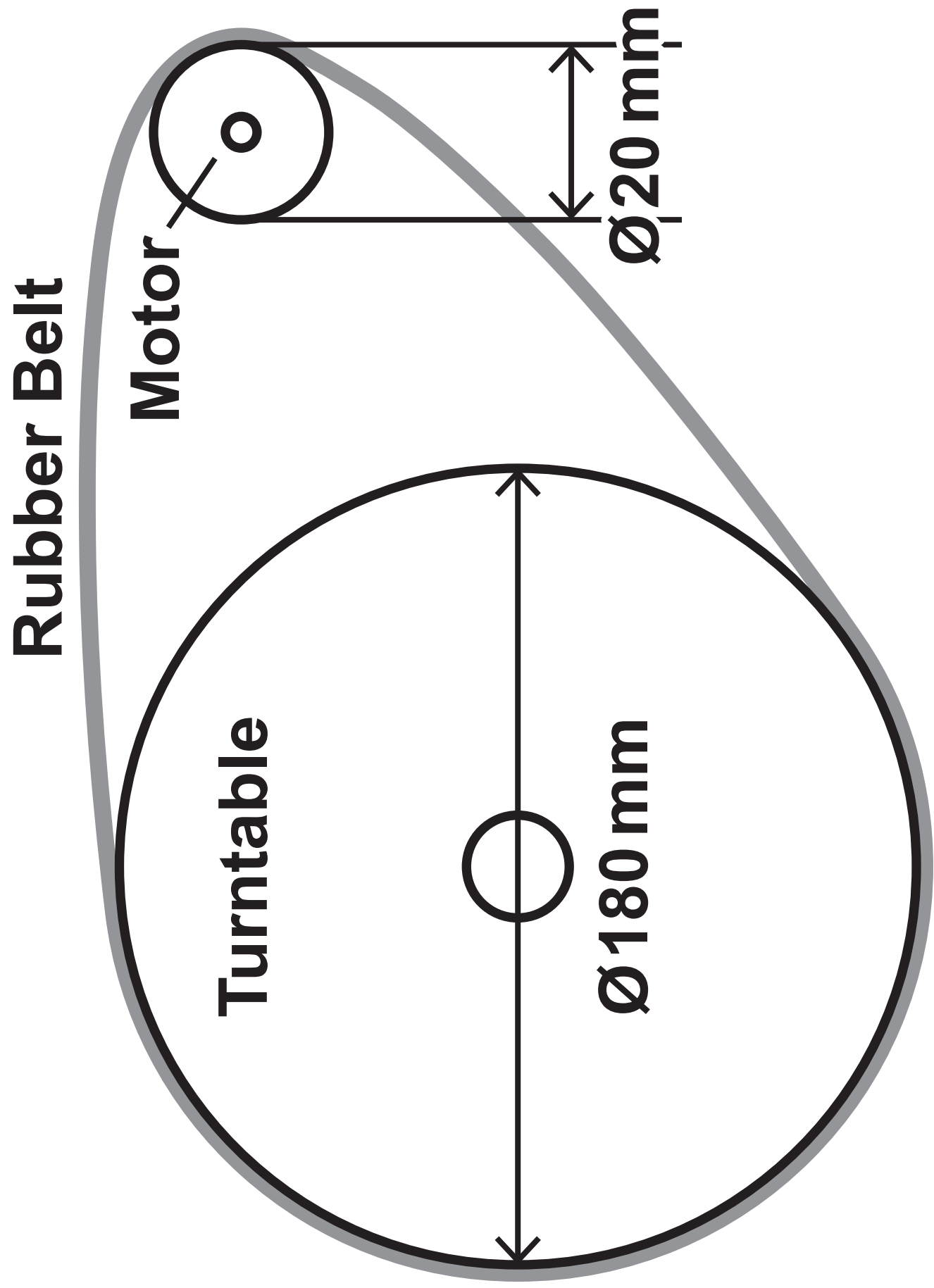
Put a tick (✓) in the grid below to indicate which record speed would take longer to play. [1 mark]

	33 rpm	45 rpm
Record		

(iv) Calculate the number of times a 45rpm record will rotate in 4 minutes. Show all workings. [2 marks]

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TURN OVER



3 (b) The image on the opposite page is of the record player's pulley and belt drive.

**(i) Calculate the velocity ratio of the driven pulley. [2 marks]
Show all workings.**

(Turn over)

3 (b)(ii)

Describe the differences between a simple gear train and a pulley and belt drive. [4 marks]

continue answer on next page

(Turn over)

3 (c) Technology push and market pull help product development.

**Discuss why products that download or stream music have increased in popularity over recent years.
[4 marks]**

continue answer on next page

(Turn over)

This question is about materials.

4 (a) The image below shows a child's puzzle made from a laminated board.



(i) Describe how a laminated board is formed. [2 marks]

continue answer on next page (Turn over)

4 (a)(ii)

Explain, using an example, how the aesthetics of the puzzle can be improved. [2 marks]

(Turn over)

4 (b) The images below show a cuff bracelet made from aluminium with a decorative finish applied.



(i) Identify TWO properties that make aluminium a suitable metal for the cuff bracelet. 2 × [1 mark]

Property 1:

Property 2:

(Turn over)

4 (b)(ii)

Unfinished aluminium can be affected by oxidation. Describe how oxidation affects the appearance of aluminium. [2 marks]

(Turn over)

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TURN OVER

	THERMOFORMING	THERMOSETTING
Polypropylene (PP)		
Melamine formaldehyde (MF)		

4 (c) The picture below shows two drinking cups made from different polymers.



**Polypropylene
(PP)**



**Melamine
formaldehyde
(MF)**

(i) Put ONE tick (✓) in the table on the opposite page to identify whether each polymer is thermoforming or thermosetting. 2 × [1 mark]

(Turn over)

4 (c)(ii)

Discuss the properties of polypropylene (PP) and melamine formaldehyde (MF) that make them suitable materials for the drinking cups. [6 marks]

continue answer on next page (Turn over)

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continue answer on next page (Turn over)

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420 mm

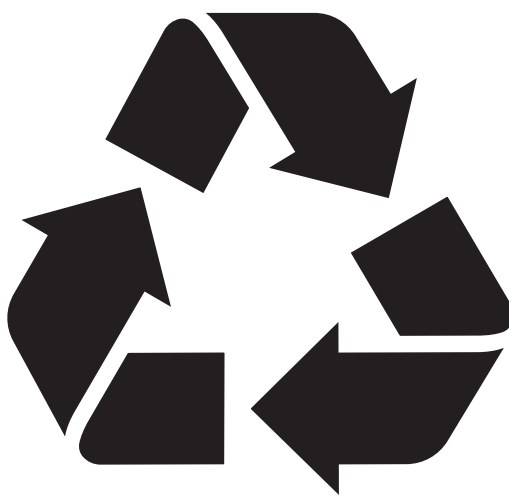
297 mm



4 (d) The image on the opposite page shows corrugated cardboard packaging used to store a drinking cup.

(i) State the correct ISO size the packaging would be cut from. [1 mark]

(ii) State the meaning of the logo pictured below that is printed on the packaging. [1 mark]



(Turn over)

4 (d)(iii)

**Describe why corrugated cardboard is a suitable material for the packaging of the drinking cup.
[2 marks]**

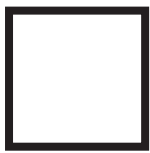
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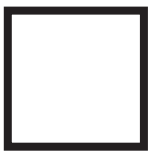
TURN OVER



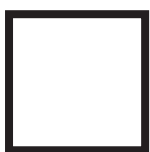
**Fabric sew
kit**



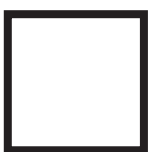
**Cardboard
build kit**



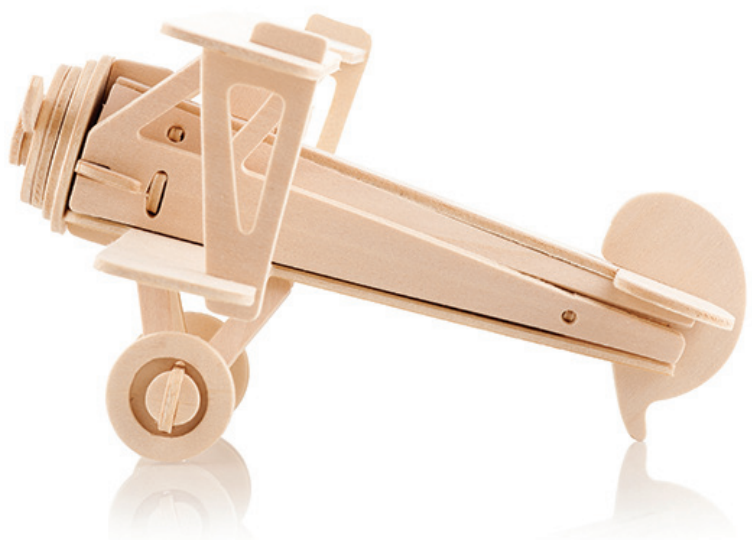
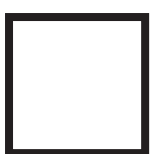
**Plastic build
kit**



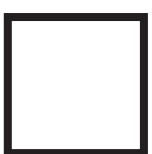
**Metal build
kit**



**Radio systems
build kit**



**Timber build
kit**



5 Carefully study the images of kit products on the opposite page and select ONE kit product to refer to when answering the questions (a) to (c). Place a tick (✓) in the box of your selected product.

(i) State a suitable target market for your selected product. [1 mark]

(Turn over)

5 (a)(ii)

Describe TWO problems the target market selected in 5(a)(i) on page 32 could have when constructing and using the kit product chosen.

2 × [2 marks]

Problem 1:

continue answer on next page

(Turn over)

Problem 2:

(Turn over)

5 (a)(iii)

The kit's product designer produced a working drawing.

Describe the information the designer would include in the working drawing. [4 marks]

continue answer on next page (Turn over)

5 (b)(i)

Systems thinking is a creative design strategy.

Describe the importance of systems thinking when improving products.

[2 marks]

(Turn over)

5 (b)(ii)

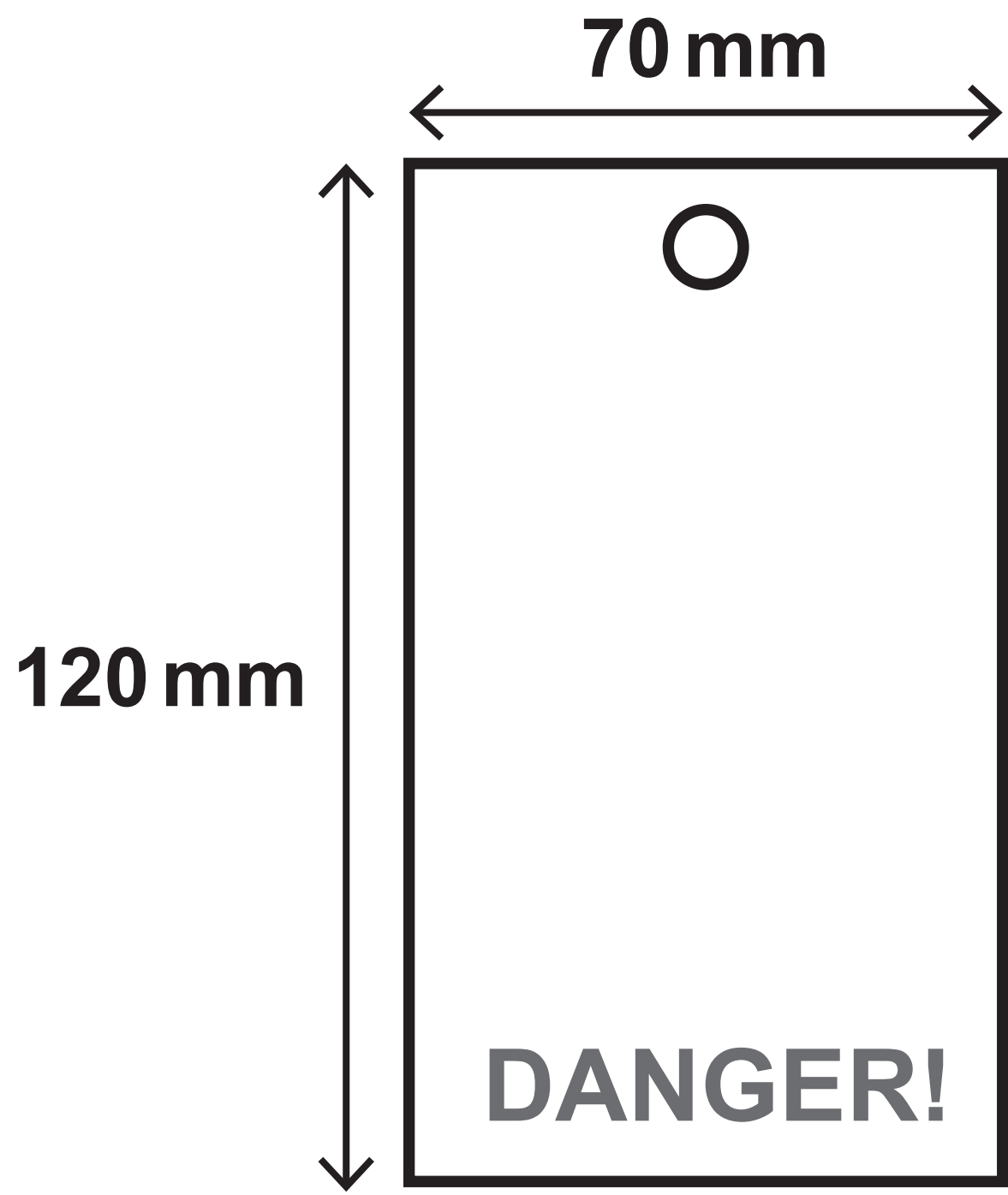
Analyse how user testing benefits product development. [4 marks]

continue answer on next page

(Turn over)

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TURN OVER



5 (c) The diagram on the opposite page is of a swing tag that is attached to each of the kit products.

The swing tags are laser cut from card sheets that measure $4\text{m} \times 2\text{m}$. Calculate the maximum number of swing tags that can be cut from 12 card sheets.

Show all workings. [5 marks]

continue answer on next page (Turn over)

SECTION B: OPTIONAL QUESTIONS

Choose **ONE** TOPIC AREA ONLY.

Place a tick (✓) in **ONE** of the boxes below to show which topic you are answering.

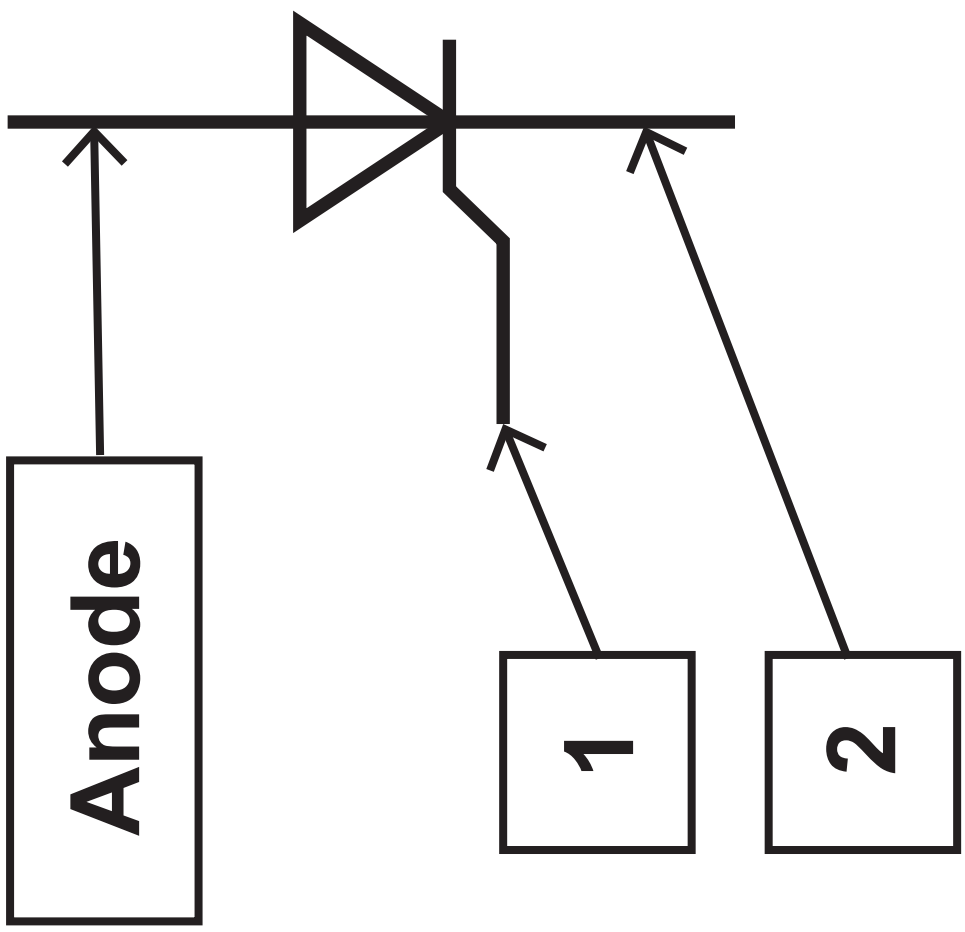
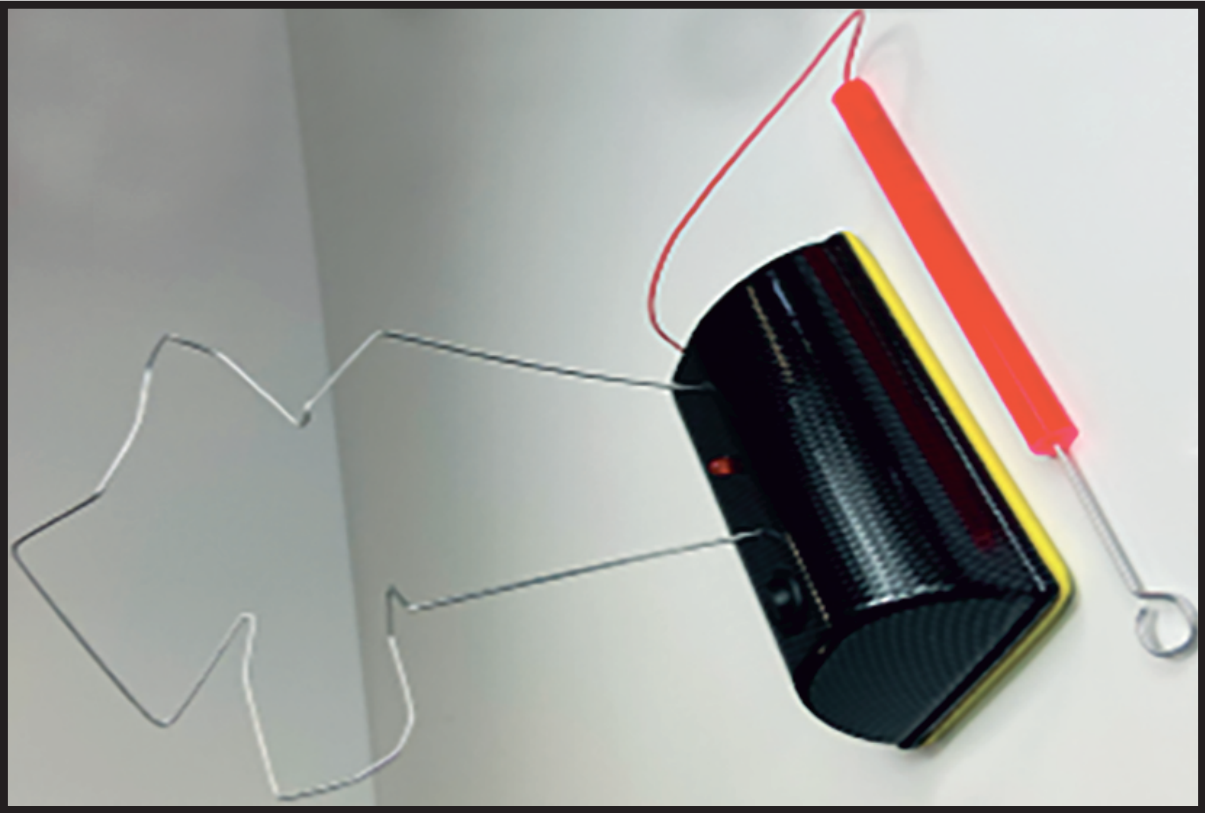
	Pages
☐ Electronic systems, programmable components and mechanical devices	43–53
☐ Papers and boards	54–64
☐ Natural and manufactured timber	65–75
☐ Ferrous and non-ferrous metals	76–86
☐ Thermosetting and thermoforming plastics	87–97
☐ Fibres and textiles	98–108

Now answer all parts of your chosen topic.

(Turn over)

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**6 ELECTRONIC SYSTEMS,
PROGRAMMABLE COMPONENTS,
AND MECHANICAL DEVICES.**

(a) The picture on the opposite page shows a steady hand game. The game contains a thyristor circuit.

(i) Give the names of pins labelled 1 and 2 on the thyristor symbol on the opposite page. 2 × [1 mark]

1. _____

2. _____

(Turn over)

6 (a)(ii)

**Describe ONE advantage of using a thyristor in the steady hand game.
[2 marks]**

(Turn over)

6 (a)(iii)

The image below shows a piece of hand-held equipment used to remove the excess wire from a populated circuit board.



State the correct name of the equipment shown. [1 mark]

(Turn over)

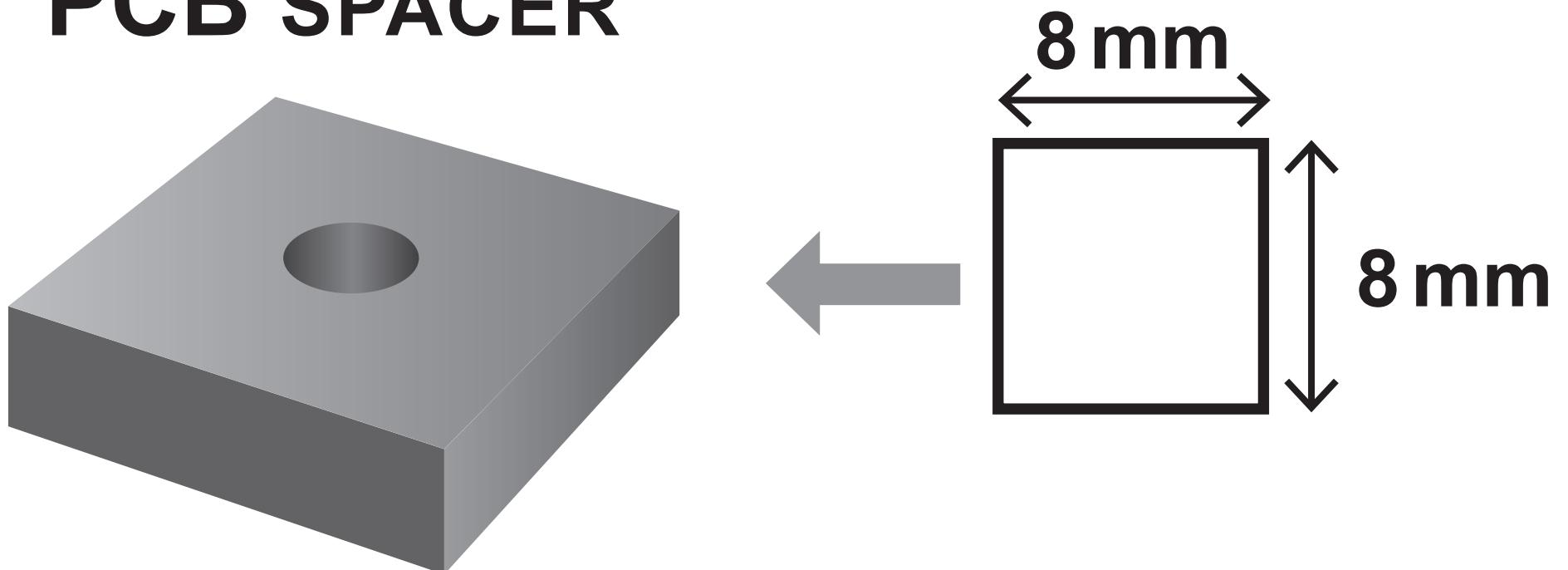
6 (a)(iv)

Precise soldering is important when populating the pre-drilled PCB for the steady hand game. In the space below, use words and sketches to show how a resistor would be soldered onto a circuit board precisely and securely. [4 marks]

(Turn over)

- 6 (b) The steady hand game circuit board is lifted from its casing using 4 spacers. The material required for each spacer measures 8 mm^2 .**

PCB SPACER



- (i) Each spacer needs a profile tool path allowance of 1.5 mm . Calculate the length of one spacer with the profile tool path allowance. [1 mark]**

(Turn over)

6 (b)(ii)

The spacers are to be cut from a piece of plastic that is 110 mm wide. Calculate the length of plastic needed to manufacture 200 steady hand game spacers. Show all workings. [4 marks]

continue answer on next page

(Turn over)

6 (c) In commercial manufacture, PCBs are cut using a CNC machine. Analyse the advantages and disadvantages of cutting PCBs using a CNC machine. [5 marks]

continue answer on next page

(Turn over)

6 (d) Discuss how designers can improve and extend the life of electronic products to lessen their impact on our environment. [6 marks]

continue answer on next page (Turn over)

[illegible]

(Turn over)

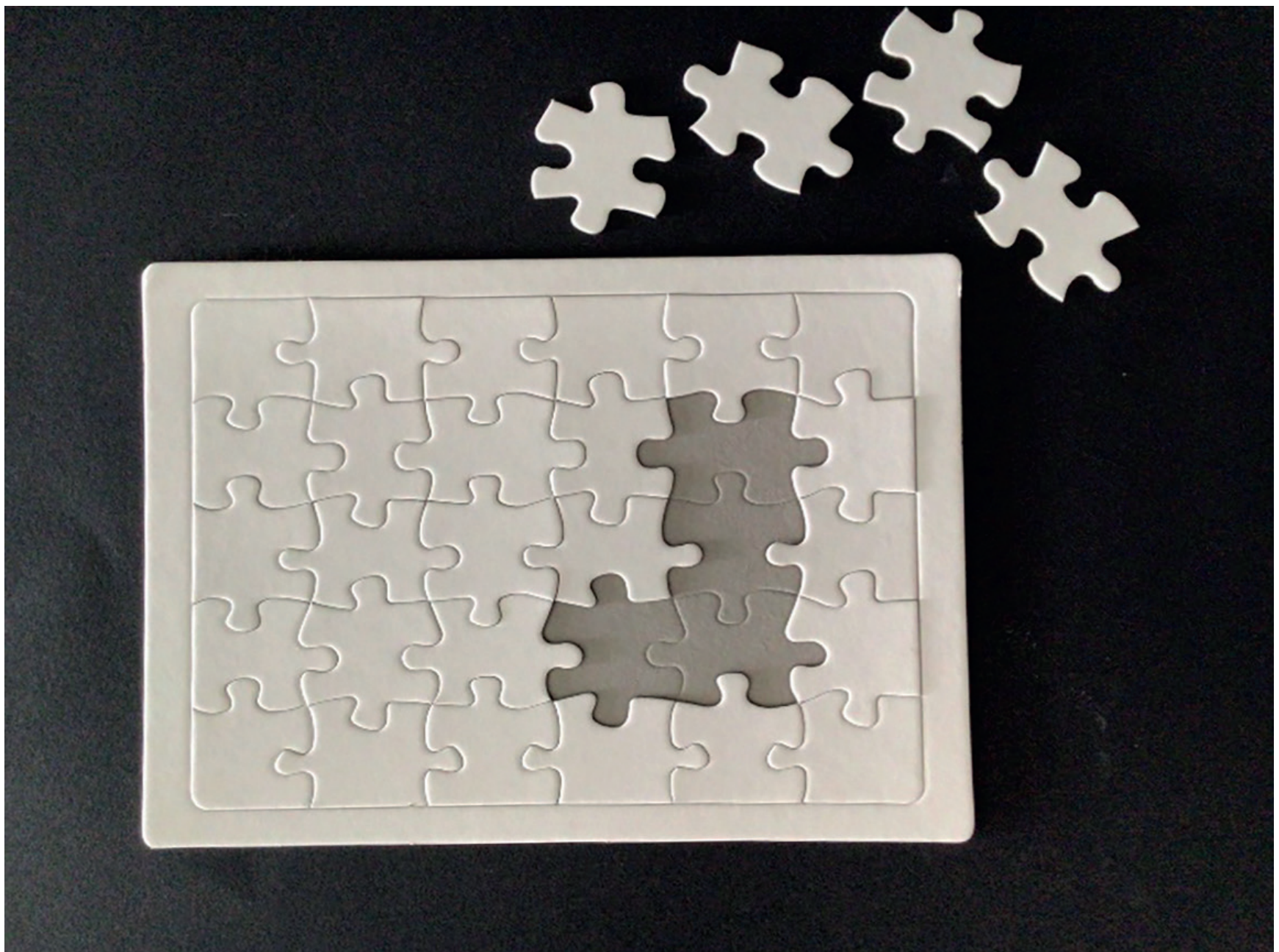
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TURN OVER

EXAMPLE	
Paper	
Board	

6 PAPERS AND BOARDS

- (a) The product below is a blank puzzle for children to design their own pictures or patterns by drawing and colouring them in.



- (i) Papers, boards and card are available in many different types. In the table on the opposite page, give an example of a paper and a board.
2 × [1 mark]

(Turn over)

6 (a)(ii)

Papers, boards and card can have surface finishes applied for different purposes. Describe ONE advantage of applying a surface finish on papers, board and card. [2 marks]

(Turn over)

6 (a)(iii)

The image below shows a piece of hand-held equipment that is used to cut cardboard.

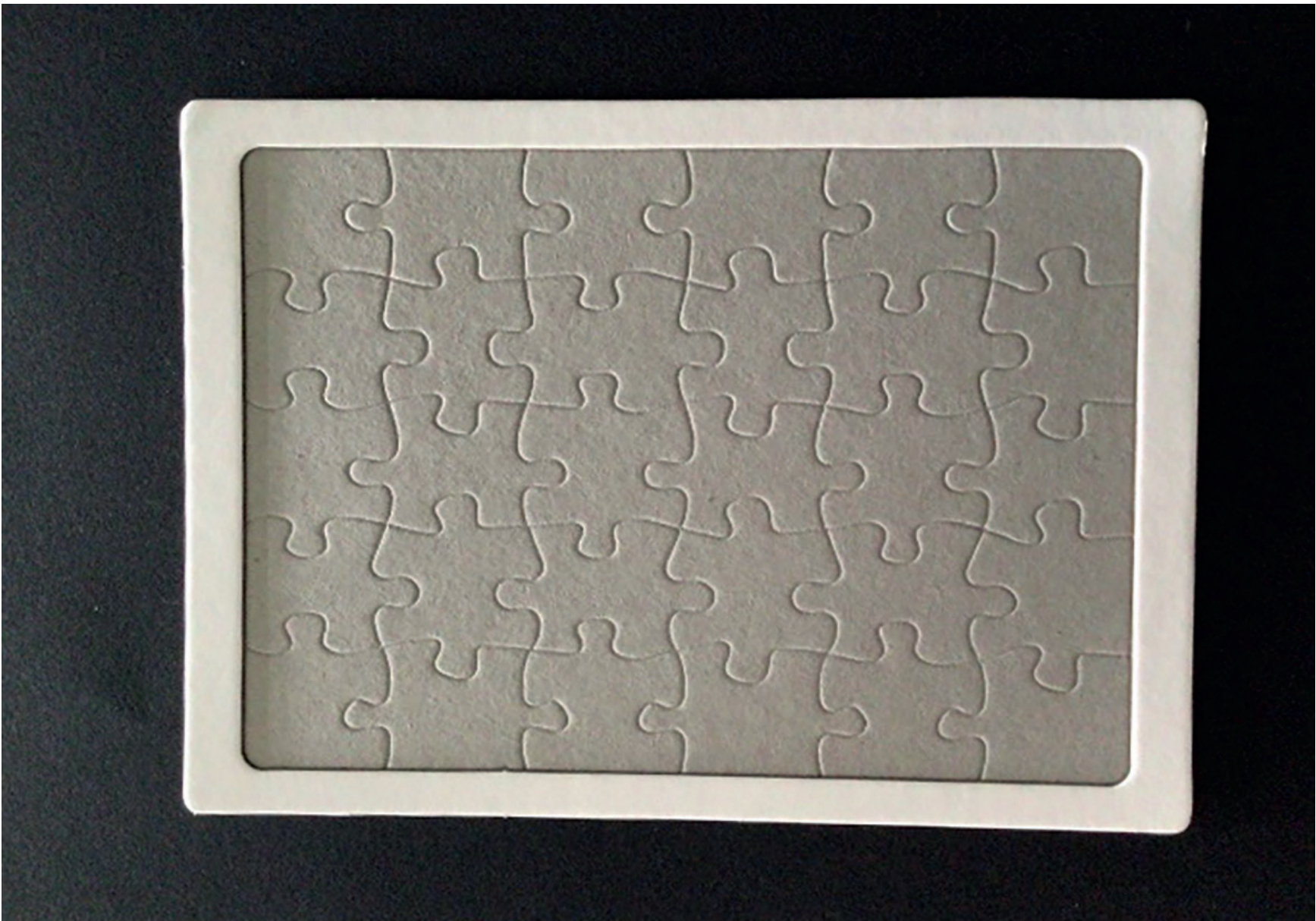


State the correct name of the equipment shown. [1 mark]

(Turn over)

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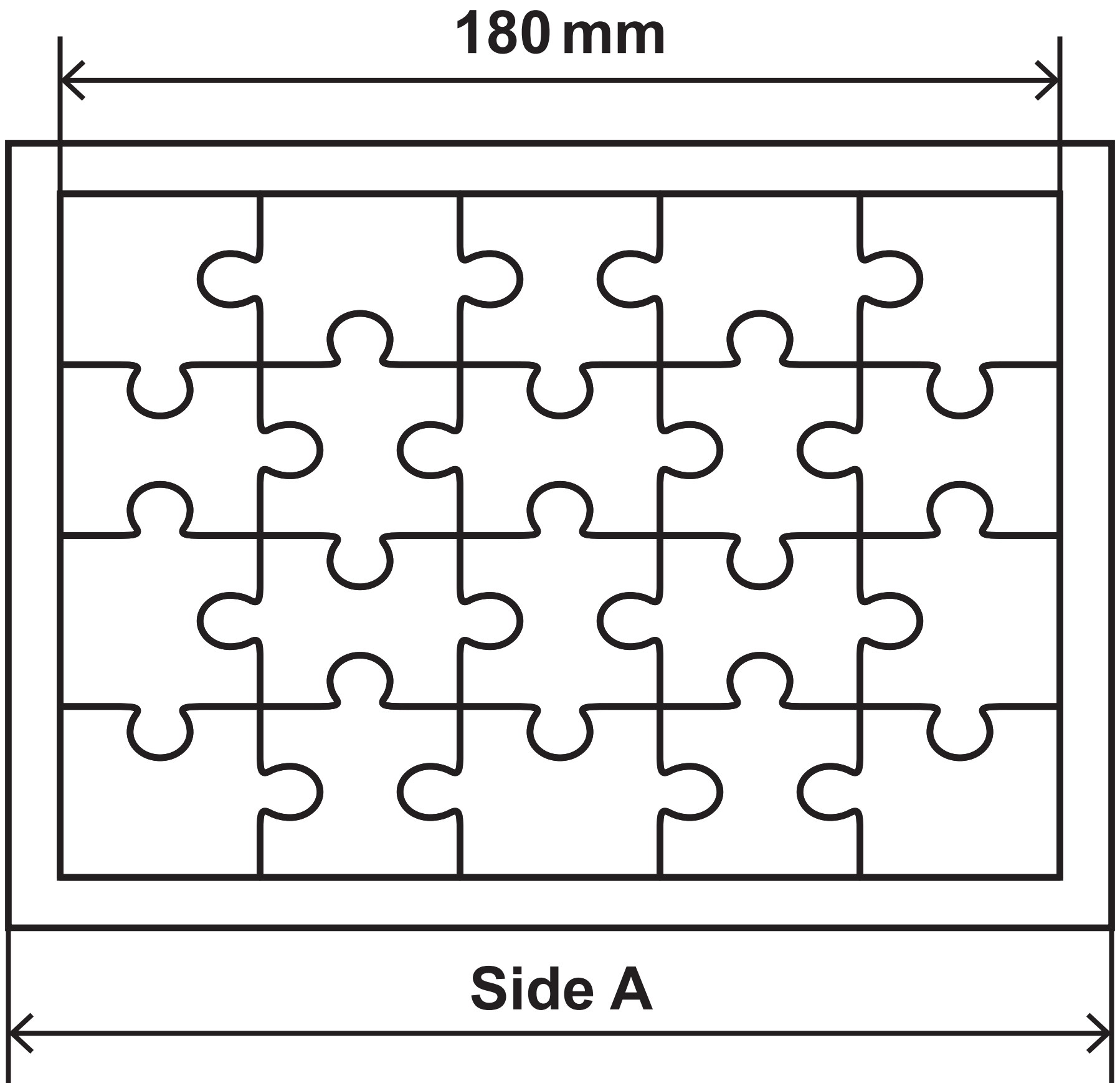
6 (a)(iv)

Accuracy is important when cutting cardboard.

In the space below, use words and sketches to show how the puzzle frame pictured on the opposite page can be marked out and cut precisely and accurately using hand tools and equipment. [4 marks]

(Turn over)

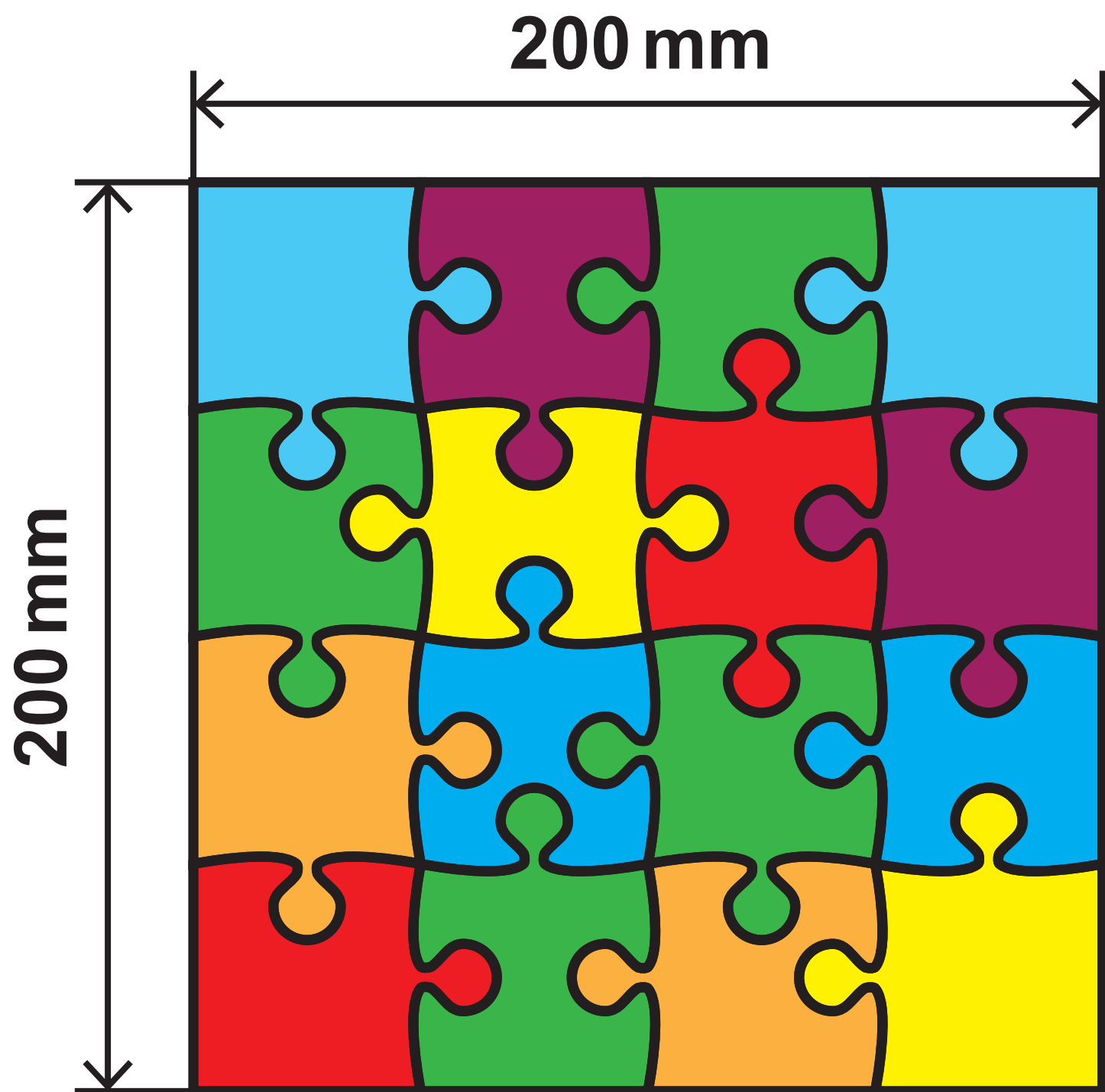
6 (b) The 20-piece puzzle below fits into a frame that has a 10 mm border.



- (i) Calculate the length of side A on the diagram. [1 mark]**

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6 (b)(ii)

**A die cutter is used to cut the
16-piece puzzle on the opposite page
from a cardboard roll.
The cardboard roll is 1 metre wide.**

**Calculate the length of cardboard roll
needed to manufacture 500 puzzles
in metres.**

Show all workings. [4 marks]

continue answer on next page (Turn over)

6 (c) In commercial design and manufacture, prototypes of card puzzles may be laser cut. Analyse the advantages and disadvantages of laser cutting card. [5 marks]

continue answer on next page

(Turn over)

6 (d) Discuss how designers can improve and extend the life of papers, boards and card products to lessen their impact on our environment. [6 marks]

continue answer on next page (Turn over)

(Turn over)

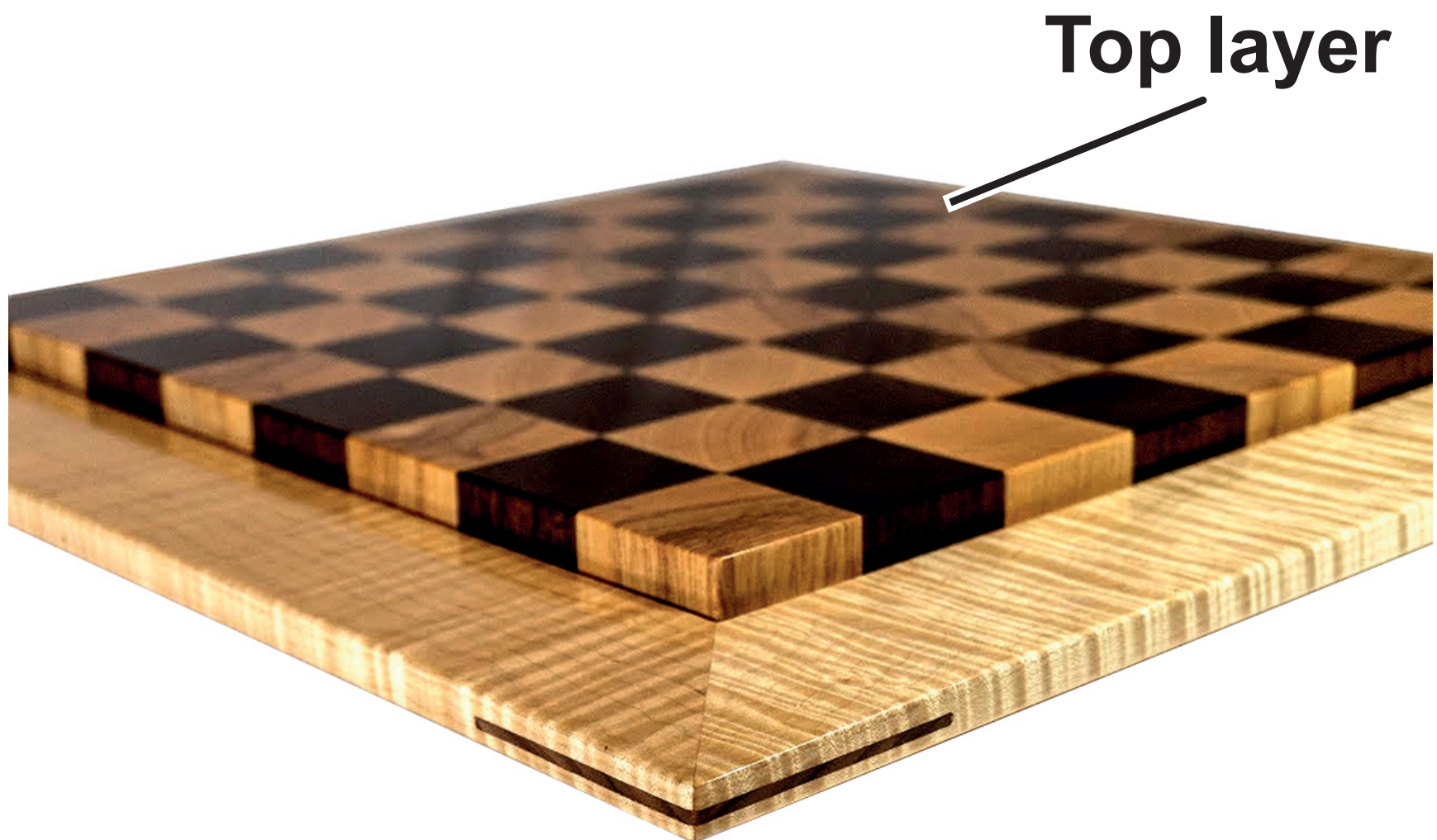
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EXAMPLE	
Hardwood	
Softwood	

6 NATURAL AND MANUFACTURED TIMBER

- (a) The picture below shows a chessboard.



- (i) The top layer of the chessboard is made from reused hardwoods and softwoods. In the table on the opposite page, give an example of a hardwood and a softwood.
2 × [1 mark]

(Turn over)

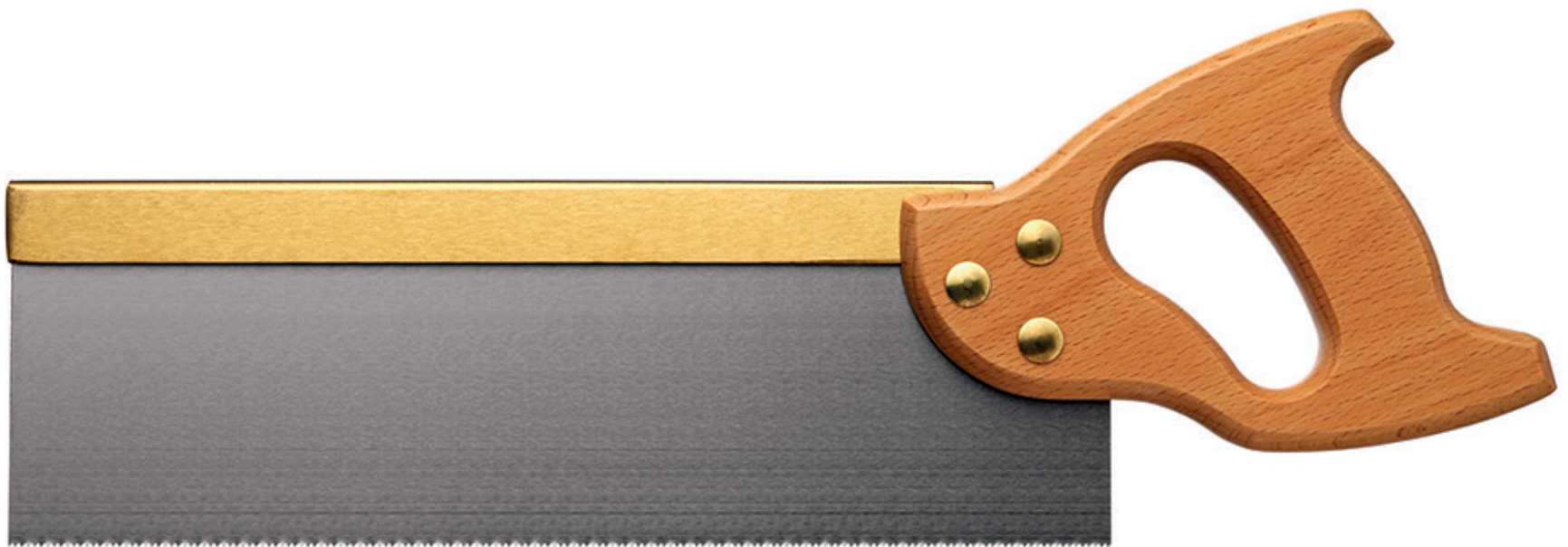
6 (a)(ii)

Wood fibres can be compressed and glued together to make manmade boards. Other than cost, describe ONE advantage of using manmade boards. [2 marks]

(Turn over)

6 (a)(iii)

The image below shows a piece of hand-held equipment used to cut the wooden squares of the chessboard.



State the correct name of the equipment shown. [1 mark]

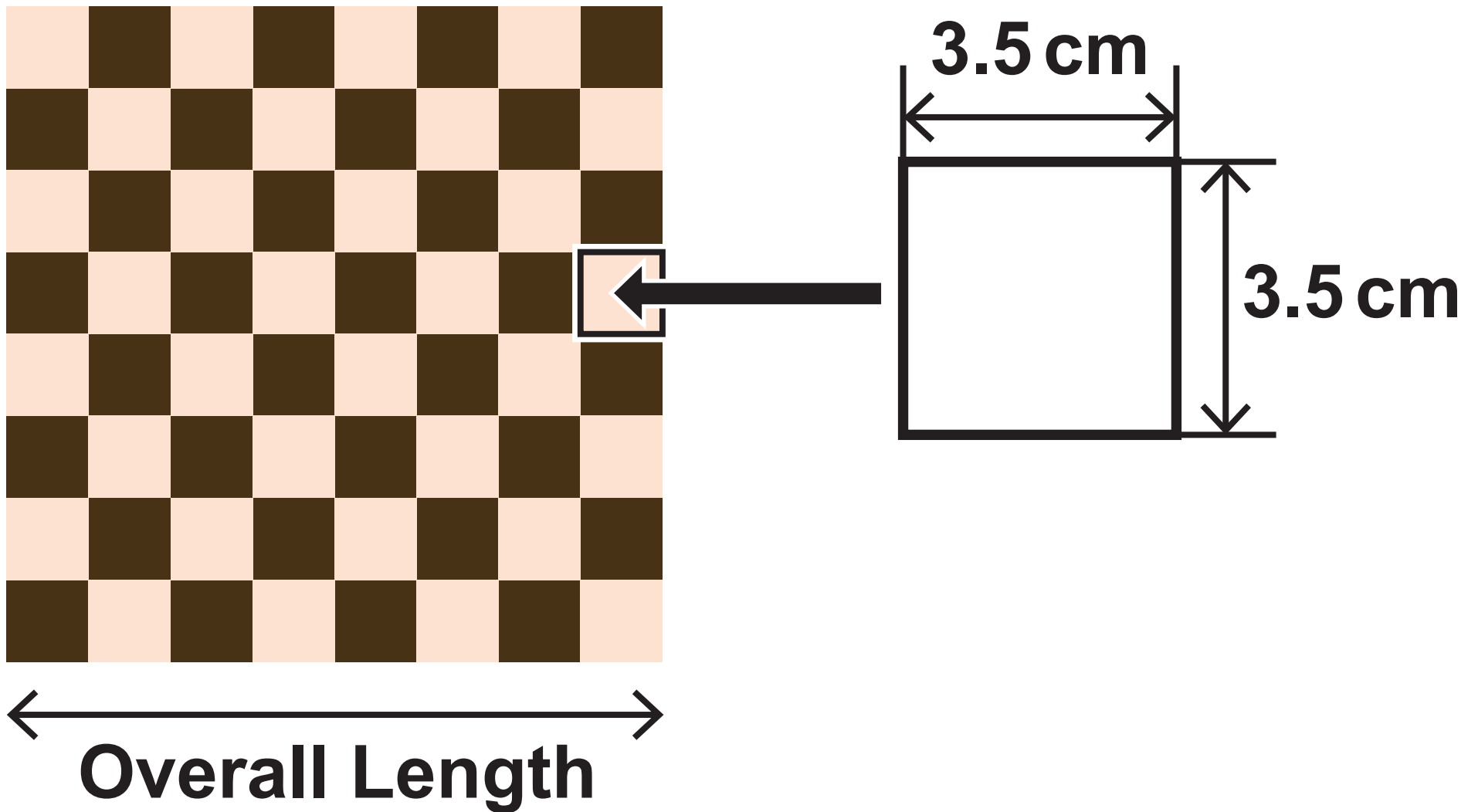
(Turn over)

6 (a)(iv)

Precise construction is important when producing the chessboard. In the space below, use words and sketches to show how the chessboard's top layer is constructed. [4 marks]

(Turn over)

- 6 (b) The chessboard is made from 64 equally sized squares of wood. The sides of each wooden square measures 3.5 cm.**

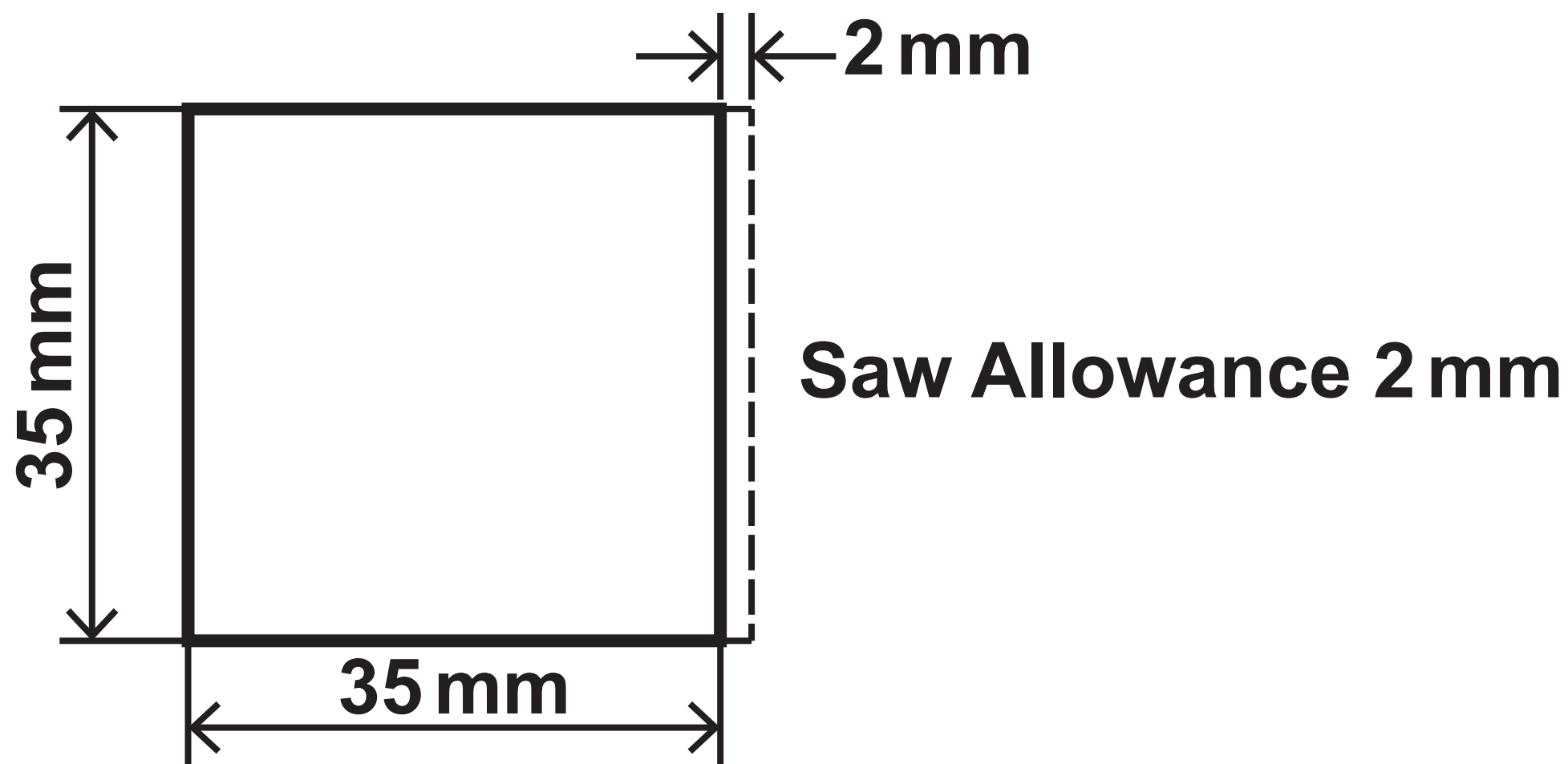


- (i) Calculate the overall length of the chessboard. [1 mark]**

(Turn over)

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6 (b)(ii)

The squares of the chessboard are cut from lengths of wood that are 3.5 cm wide. An allowance of 2 mm needs to be included for the saw blade. This is shown in the diagram on the opposite page.

**Calculate the total length of hardwood and softwood needed to manufacture 25 chessboards.
Show all workings [4 marks]**

continue answer on next page (Turn over)

6 (c) In commercial manufacture, timbers can be laser cut. Analyse the advantages and disadvantages of laser cutting timbers. [5 marks]

continue answer on next page (Turn over)

6 (d) Discuss how designers can improve and extend the life of wooden products to lessen their impact on our environment. [6 marks]

continue answer on next page (Turn over)

(Turn over)

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Ferrous	EXAMPLE	
Non-ferrous		

6 FERROUS AND NON-FERROUS METALS

- (a) The chess set shown below includes chess pieces manufactured from recycled metals.**



- (i) The metals used for the chess pieces are made from ferrous and non-ferrous metals.
In the table on the opposite page, give an example of a ferrous and a non-ferrous metal. 2 × [1 mark]**

(Turn over)

6 (a)(ii)

Metals can be combined to produce an alloy. Describe ONE advantage of using an alloy. [2 marks]

(Turn over)

6 (a)(iii)

The image below shows a piece of machinery used to manufacture the chess pieces.



State the correct name of the machine shown. [1 mark]

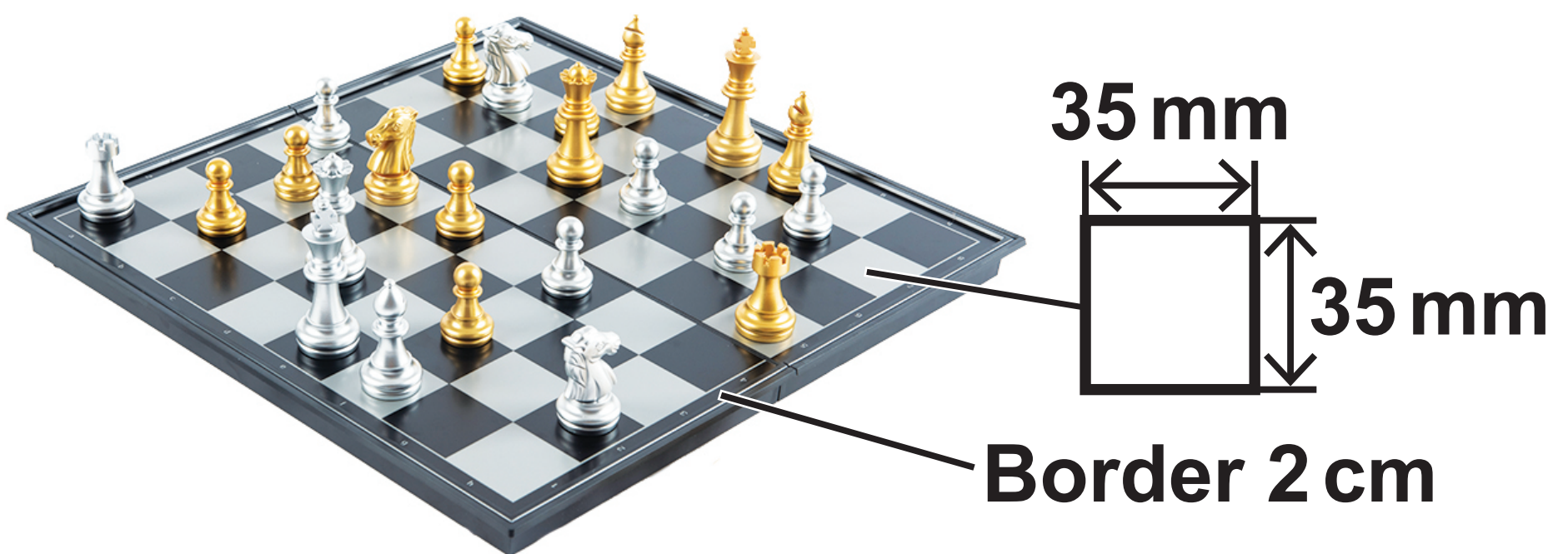
(Turn over)

6 (a)(iv)

Precise construction is important when producing chess pieces. In the space below, use words and sketches to show how one of the chess pieces could be manufactured using the machine shown. [4 marks]

(Turn over)

- 6 (b) The chessboard is made from 64 equally sized squares. The sides of each square measure 3.5 cm. There is also a 2 cm border around the edge of the board.**



- (i) The chessboard is fixed together to make a complete chessboard. Calculate the length of the chessboard including the frame. [1 mark]**
-
-

6 (b)(ii)

The chess pieces will be manufactured from a length of metal rod. The 16 small chess pieces each require 3 cm of rod and the 16 larger pieces each require 5 cm of rod. An allowance of 35 mm is required for each piece.

Calculate the total length of metal rod needed to manufacture each set of 32 chess pieces. [4 marks]

Show all workings.

continue answer on next page (Turn over)

6 (c) In commercial manufacture, chess pieces can be CNC machined. Analyse the advantages and disadvantages of CNC machining the chess pieces. [5 marks]

continue answer on next page (Turn over)

6 (d) Discuss how designers can improve and extend the life of metal products to lessen their impact on our environment. [6 marks]

continue answer on next page (Turn over)

(Turn over)

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	POLYMER EXAMPLE	
Thermoforming		
Thermosetting		

6 THERMOSETTING AND THERMOFORMING PLASTICS

- (a) The product pictured below is a stand for a mobile phone.**



The phone stand is made from a thermoforming polymer. Polymers can also be classed as thermosetting polymers.

- (i) In the table on the opposite page, state the name of a thermoforming and a thermosetting polymer.**

2 × [1 mark]

(Turn over)

6 (a)(ii)

Thermosetting polymer resins can be combined with fibres. Describe ONE advantage of adding fibres to a thermosetting polymer. [2 marks]

(Turn over)

6 (a)(iii)

The image below shows a hand-held tool used to shape the edges of sheet polymers.



State the correct name of the equipment shown. [1 mark]

(Turn over)

6 (a)(iv)

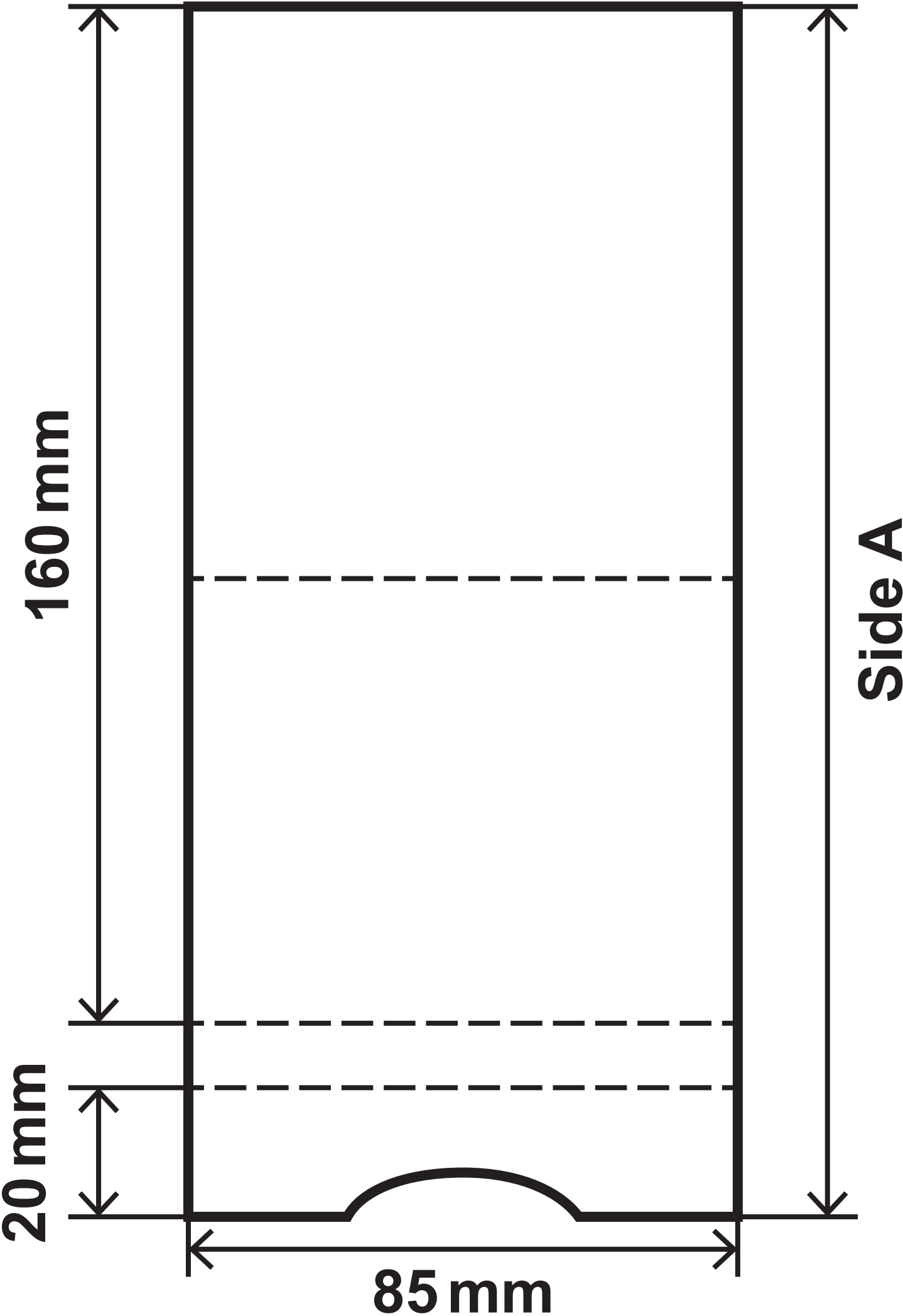
Accuracy is important when line bending sheet polymers.

In the space below, use words and sketches to show how the sheet polymer phone stand can be bent precisely and accurately. [4 marks]

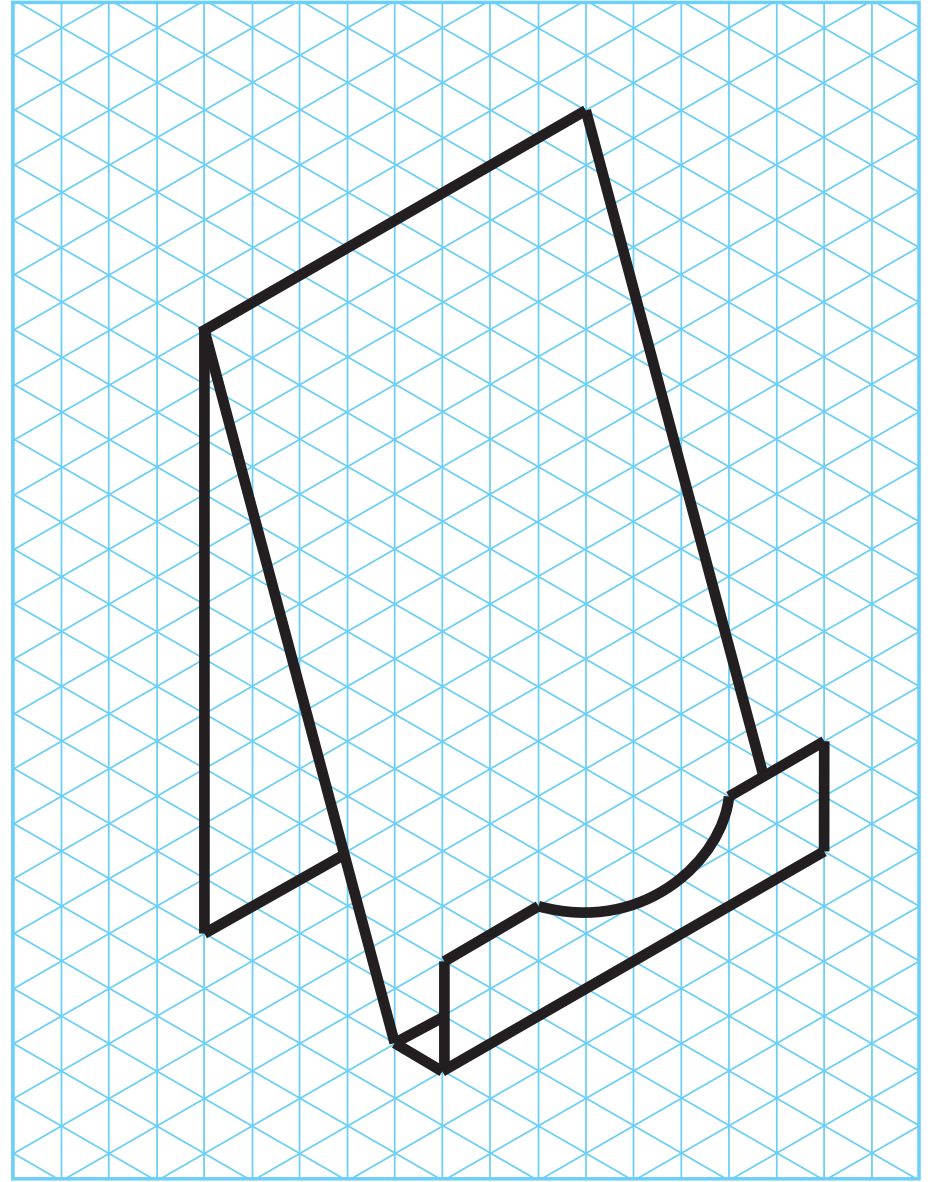
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6 (b) The design of the phone stand is shown below and on the opposite page:



The phone stand has been designed to hold a mobile phone with a thickness of 10 mm.

- (i) Calculate the length of side A.
[1 mark]**

6 (b)(ii)

**One sheet of polymer that fits the laser cutter is 600 mm × 600 mm. Calculate how many sheets would be needed to laser cut 84 phone stands. [4 marks]
Show all workings.**

continue answer on next page

(Turn over)

6 (c) In commercial manufacture, sheet polymer products can be laser cut. Analyse the advantages and disadvantages of laser cutting sheet polymers. [5 marks]

continue answer on next page (Turn over)

6 (d) Discuss how designers can improve and extend the life of polymer products to lessen their impact on our environment. [6 marks]

continue answer on next page (Turn over)

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FIBRE EXAMPLE	
Synthetic	
Natural	

6 FIBRES AND TEXTILES

- (a) The products pictured below have been covered in recycled fabric made from sewn patchwork shapes.



- (i) The fabrics used for the patchwork shapes are made from either synthetic or natural fibres. In the table on the opposite page, name an example of a synthetic and a natural fibre. 2 × [1 mark]

(Turn over)

6 (a)(ii)

Synthetic fibres can be blended with natural fibres. Describe ONE advantage of fibre blending. [2 marks]

(Turn over)

6 (a)(iii)

The image below shows a piece of hand-held equipment used to cut the fabric patchwork shapes.



State the correct name of the equipment shown. [1 mark]

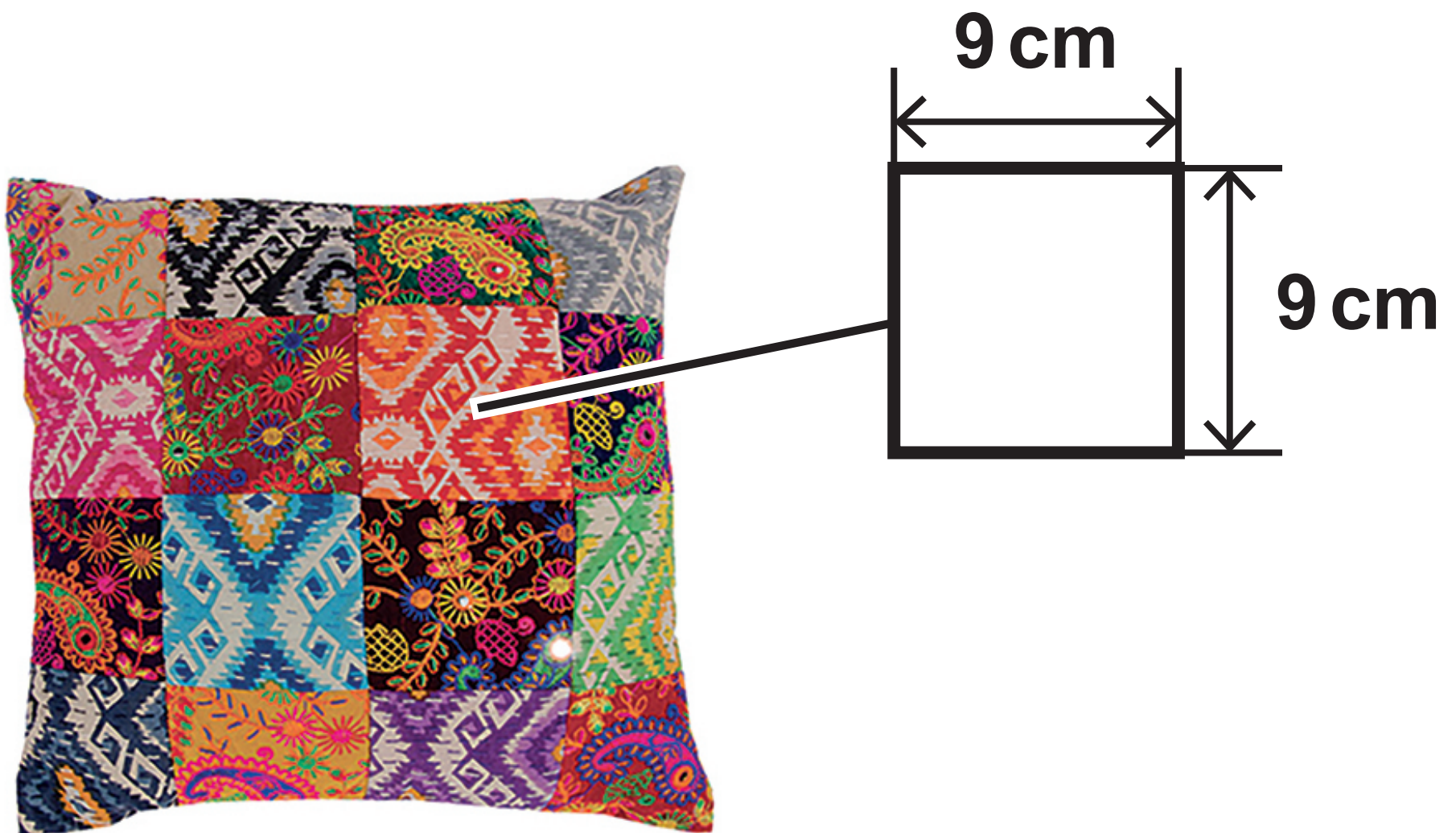
(Turn over)

6 (a)(iv)

**Precise sewing is important when producing patchwork fabric. In the space below, use words and sketches to show how two square patchwork shapes would be sewn together precisely and securely.
[4 marks]**

(Turn over)

- 6 (b) The front of the cushion is made from 16 equally sized squares of sewn fabric. Each square measures 9 cm^2 .**



- (i) Each patchwork square needs a seam allowance addition of 1.5 cm. Calculate the length of ONE patchwork square with seam allowance added. [1 mark]**
-
-

(Turn over)

6 (b)(ii)

The patchwork squares are to be cut from fabric that is 240 cm wide.

Calculate the length of fabric needed to manufacture 400 patchwork cushion fronts.

Show all workings. [4 marks]

continue answer on next page

(Turn over)

6 (c) In commercial manufacture, fabric patchwork shapes are laser cut. Analyse the advantages and disadvantages of laser cutting fabric. [5 marks]

continue answer on next page (Turn over)

6 (d) Discuss other ways designers can extend the life of textile products to lessen their impact on our environment. [6 marks]

continue answer on next page (Turn over)

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END OF PAPER

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

[illegible]

[illegible]

[illegible]