

Surname	Centre Number	Candidate Number
First name(s)		0



GCSE

C600U10-1



S23-C600U10-1



MONDAY, 19 JUNE 2023 – MORNING

DESIGN AND TECHNOLOGY

Component 1

DESIGN AND TECHNOLOGY IN THE 21st CENTURY

2 hours

ADDITIONAL MATERIALS

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

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

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid. You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

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.



JUN23C600U10101

SECTION AAnswer **all** questions

This question is about Design and Technology and our world.

1. (a) The table below compares the annual costs of an electric car with a petrol car.

	Electric Car	Petrol Car	Difference	Comparison
Purchase Cost	£28 500	£22 800	£5 700	25% more expensive
Fuel/Energy Cost	£342	£876		61% cheaper
Tax and Maintenance Cost	£225		£218	49% cheaper
Total Annual Running Cost	£1 650	£2 370	£720	

- (i) Complete the table above by calculating the missing figures.
-
- Show all workings.

[4]

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- (ii) Crude oil is an example of a non-renewable energy source. Name another non-renewable energy source.

[1]

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- (iii) A hybrid car combines a petrol or diesel engine with an electric motor. It is an example of market pull. Describe the term 'market pull'.

[2]

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- (b) Cars are manufactured globally. Explain how global manufacturing has a negative impact on our society.

[3]

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This question is about materials technology.

2. (a) Select the correct description for **each** smart material listed by placing a tick (✓) in the table below. [3]

Description	A material that changes colour when exposed to UV light.	A material that changes from an insulator to a conductor.	A material that changes colour when exposed to heat.
Photochromic			
Thermochromic			
Quantum Tunnelling Composite			

- (b) A Shape Memory Alloy (SMA) has been used for the manufacture of the eyeglass frame seen in the picture below.



Explain why a Shape Memory Alloy has been used for the eyeglass frame. [2]

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- (c) The surfboards pictured below, are coated in a Glass Reinforced Plastic (GRP). Glass Reinforced Plastic is a composite material.



Explain why a composite material is suitable for the coating of the surfboards.

[2]

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- (d) Analyse the suitability of Glass Reinforced Plastic (GRP) as a sustainable material for the surfboard.

[3]

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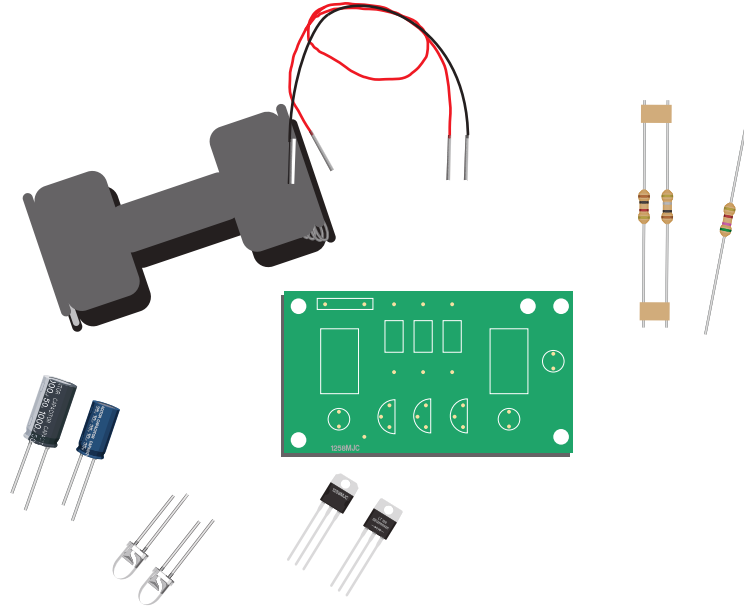
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This question is about electronic systems, programmable components and mechanical devices.

3. (a) The image below shows the electronic component parts of a flashing bike light.



- (i) On the image above, label the:

- Circuit board
- LEDs

[2]

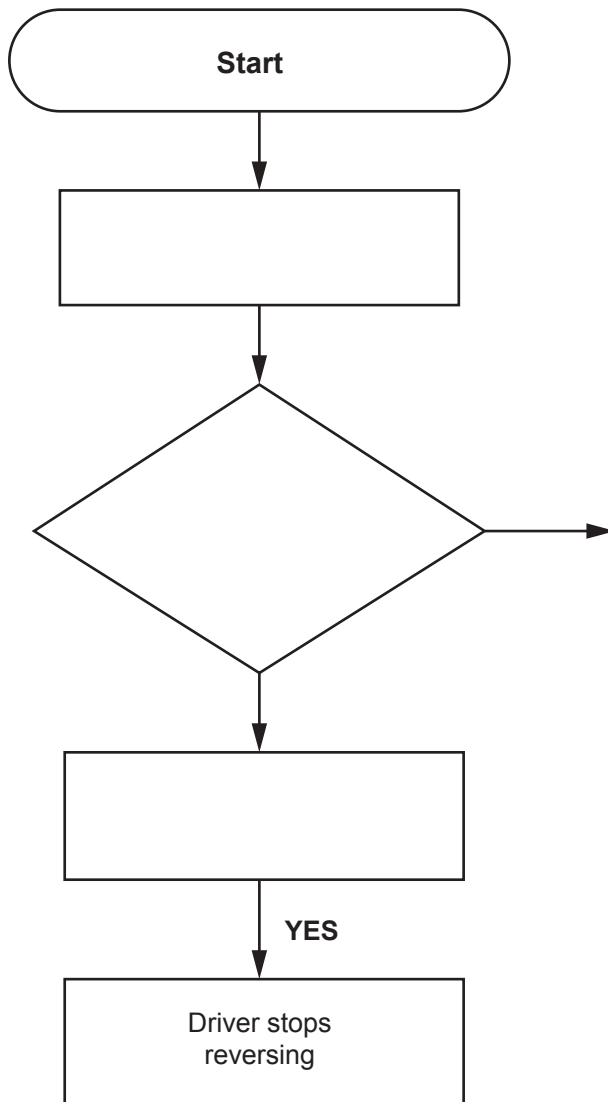
- (ii) Identify another product that could use the components of a flashing light.

[1]

- (b) The image below is of a car fitted with ultrasonic reverse parking sensors. The sensors emit a constant beeping sound when the driver is within 40 cm of an object.



- (i) Use the statements provided in the table to complete the flow chart to show how the parking sensors operate. [4]



Parking sensor statements:

Car senses barrier 40 cm away?

No

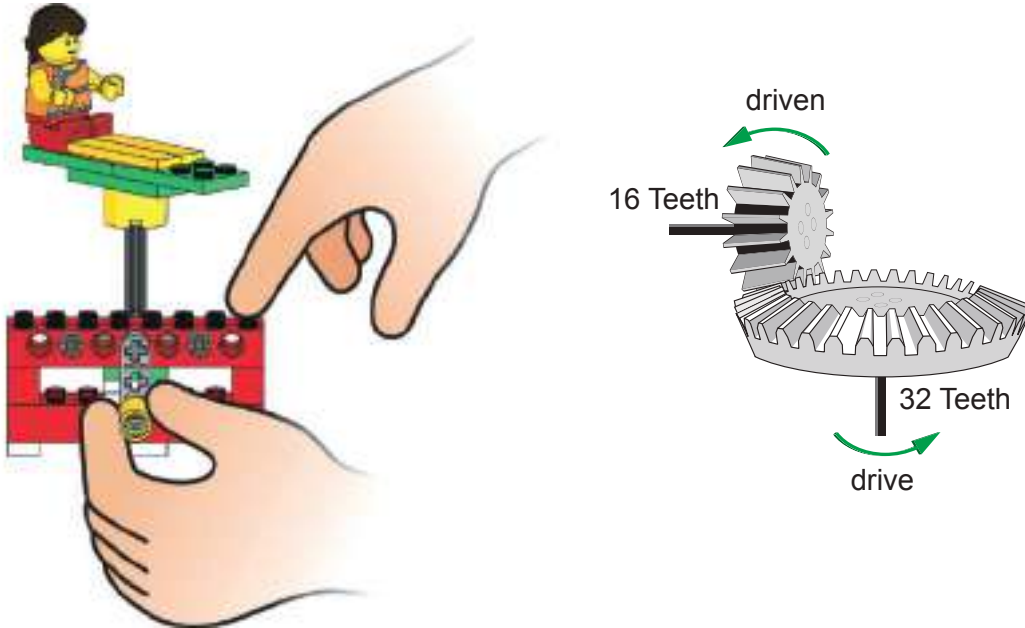
Continuous beeping sound

Driver reverses car

- (ii) On the flow chart above, draw the feedback route for the parking sensors. [1]



- (c) The image below is of a LEGO merry-go-round product that uses a gear mechanism.



- (i) The handle turns the drive gear which has 32 teeth and the driven gear which has 16 teeth. Calculate the gear ratio. [2]
Show all workings.

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- (ii) If the handle rotates three times, calculate how many full rotations the merry-go-round will make. [2]
Show all workings.

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- (iii) Using an example of a named product explain the motion of a rack and pinion gear. [3]

Name of Product:

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This question is about materials.

4. (a) The images below show a packaging product made from recycled paper.



Closed



Open



Packaging wrapped around a
glass bottle

- (i) Draw a circle around the correct words to complete the sentences that follow.

2 × [1]

The weight of paper is measured in	grams per square inch grams per square metre
Each time paper fibres get recycled they become	weaker stronger

- (ii) Describe how the designer has considered the safety of the product being packaged.

[2]

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- (b) The image below is of a toothbrush made from beech wood.



- (i) Beech is a hardwood that comes from deciduous trees. Identify **two** characteristics of a deciduous tree.

2 × [1]

Characteristic 1:

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Characteristic 2:

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- (ii) Describe why beech wood is a suitable material for the toothbrush. [2]

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- (c) The picture below is of a bag made from a PVC coated nylon fabric.



- (i) State the meaning of PVC. [1]

Polyvinyl C

- (ii) Identify a suitable target market the bag would appeal to. [1]

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- (iii) Discuss the reasons why PVC coated nylon is a suitable material for the bag. [4]

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- (iv) Describe **one** reason why a knitted fabric would be an unsuitable choice for the bag. [2]

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- (d) The image below is a necklace made from copper and pewter.



- (i) Copper and pewter are non-ferrous metals. Define the term non-ferrous. [1]

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- (ii) Other than copper and pewter, give **one** example of a non-ferrous metal suitable for jewellery. [1]

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- (iii) Explain how the properties of non-ferrous metals make them suitable for jewellery. [2]

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5. Study the images below showing an electric cargo bike and its accessories. Select **one** product to refer to when answering the questions (a) to (c) if appropriate. Place a tick (✓) in the box of your selected product.


☐ wooden container

☐ metal bike frame

☐ battery pack

☐ plastic child's seat

☐ cardboard game

☐ fabric head support

- (a) (i) State **one** specific material suitable for the product selected.

[1]

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- (ii) Evaluate the suitability of the material in (i) opposite for the product selected. [3]

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- (b) (i) Identify **two** anthropometric considerations for your chosen product. [2]

Consideration 1:

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Consideration 2:

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- (ii) Evaluate the ergonomic design of your chosen product. [4]

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- (c) (i) The designer undertakes a disassembly activity by taking apart a competitor's product before designing the electric cargo bike.

Describe how disassembly can be a useful activity to a designer. [4]

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- (ii) Write a design brief for the electric cargo bike that reflects its function. [2]

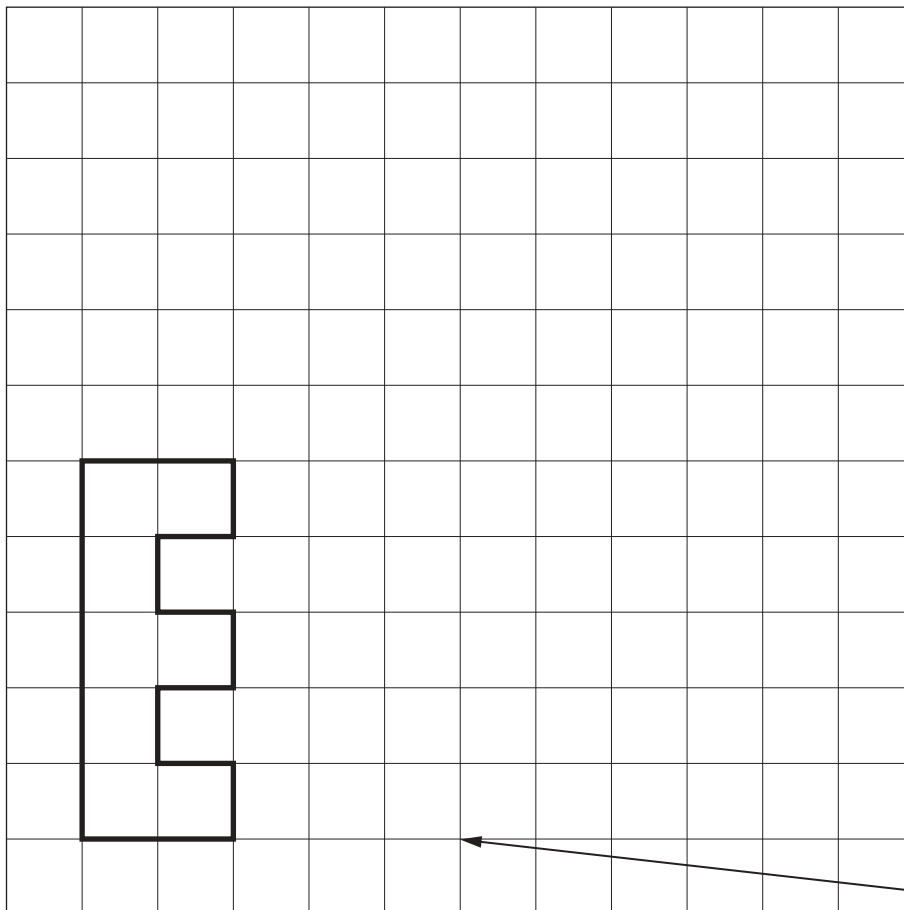
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- (d) The company that manufactures the electric cargo bike wants to rebrand all their products by adding a logo based on the letter **E**.

- (i) Using the squared grid below, redraw the letter **E** shown, so that its area is four times greater. [3]



- (ii) If the area of one square is equal to 5 cm^2 calculate the total area of the letter **E** you have drawn. [1]

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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.

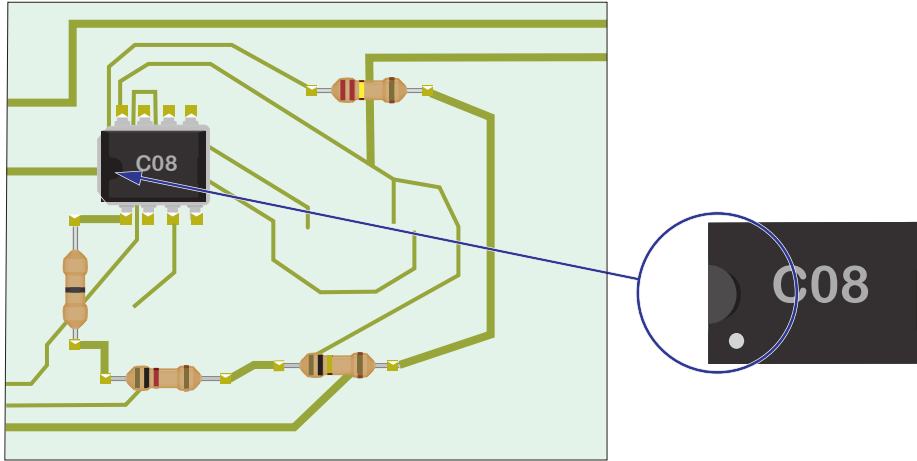
		Pages
Electronic systems, programmable components and mechanical devices	☐	18–21
Papers and boards	☐	22–27
Natural and manufactured timber	☐	28–31
Ferrous and non-ferrous metals	☐	32–36
Thermosetting and thermoforming plastics	☐	38–42
Fibres and textiles	☐	44–47

Now answer all parts of your chosen topic.



6. Electronic systems, programable components and mechanical systems

- (a) The picture below shows an eight-pin IC (integrated circuit) on a circuit board.



- (i) State the purpose of the notch circled in the picture.

[1]

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- (ii) Identify **one** reason for the colour bands on the resistors.

[1]

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- (iii) Explain the benefits of using printed circuit boards in the manufacture of modern electronic equipment.

[2]

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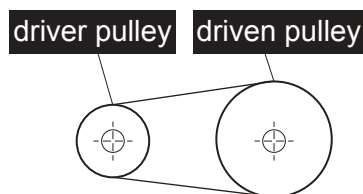
- (iv) The image below shows an industrial piece of equipment used to create holes in the circuit board.



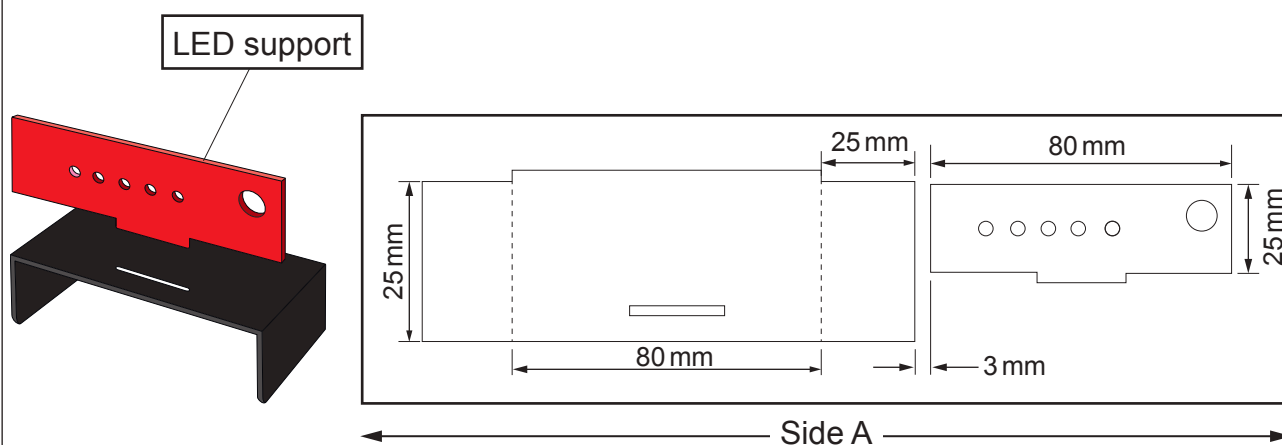
State the correct name of the equipment.

[1]

- (v) The image below shows a simple pulley system. In the space below, use notes and sketches to show how the pulleys can be modified to turn at the same speed and in opposite directions. [4]



- (b) The measurements of a circuit board housing are shown below.



- (i) Calculate the minimum length of Side A to manufacture **one** circuit board housing. Select your final answer by correctly circling **one** of the measurements provided below. Show all workings. [2]

238 mm

213 mm

200 mm

185 mm

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- (ii) The manufacturer decides to laser cut the LED support. Calculate how many LED support pieces can be cut from a sheet of plastic that measures 200 cm × 90 cm. Show all workings. [3]

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- (c) The circuit boards are manufactured in an economically developing country. Analyse how a designer can ensure that the circuit boards are manufactured in an ethical and environmentally friendly way. [5]

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- (d) A prototype circuit board is tested and evaluated during the process of designing and making.

Evaluate the need for testing and evaluating.

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6. Papers and boards

- (a) The picture below shows packaging of Philippe Starck's iconic product the Juicy Salif made by Alessi.



The packaging has a shiny gloss finish.

- (i) State the method used to create the shiny gloss finish on the packaging. [1]

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- (ii) Identify **one** benefit of applying a shiny gloss finish. [1]

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- (iii) The packaging is designed to include tabs.

Explain why tabs are used in the construction of the packaging [2]

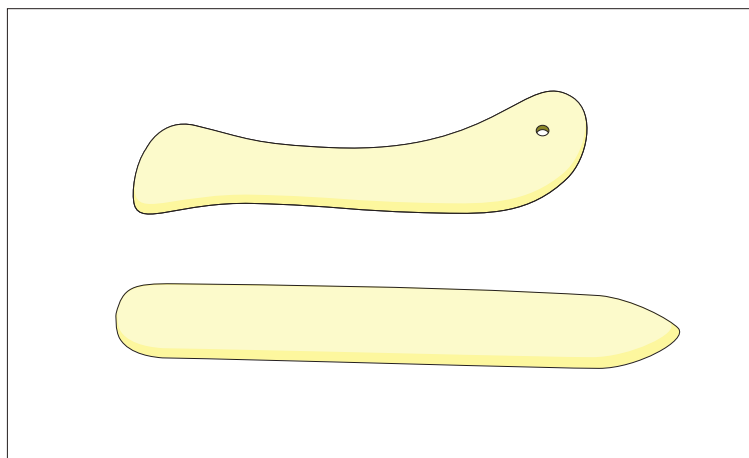
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- (iv) The image below shows graphics equipment used to create a clean, sharp fold in the packaging nets.



State the name of the equipment.

[1]

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- (v) The image below shows the packaging box for the Juicy Salif.

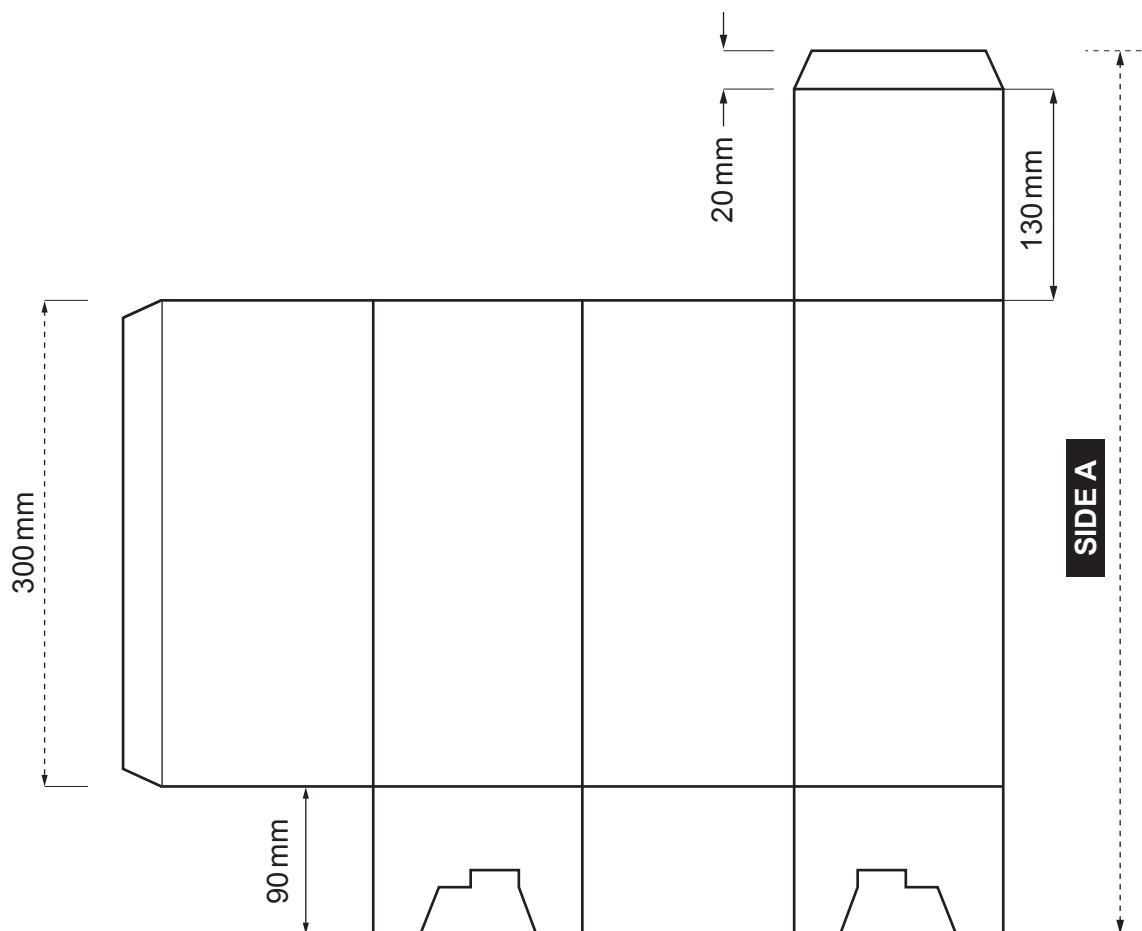


In the space below use annotated sketches to design a cardboard insert to stop the Juicy Salif from moving around when it is in the packaging box. [4]



- (b) (i) Measurements for a packaging net are shown below.

Calculate the minimum length of material to manufacture **Side A** of the packaging net.



Select your final answer by circling **one** of the measurements provided below. Show all workings. [2]

520 mm

540 mm

560 mm

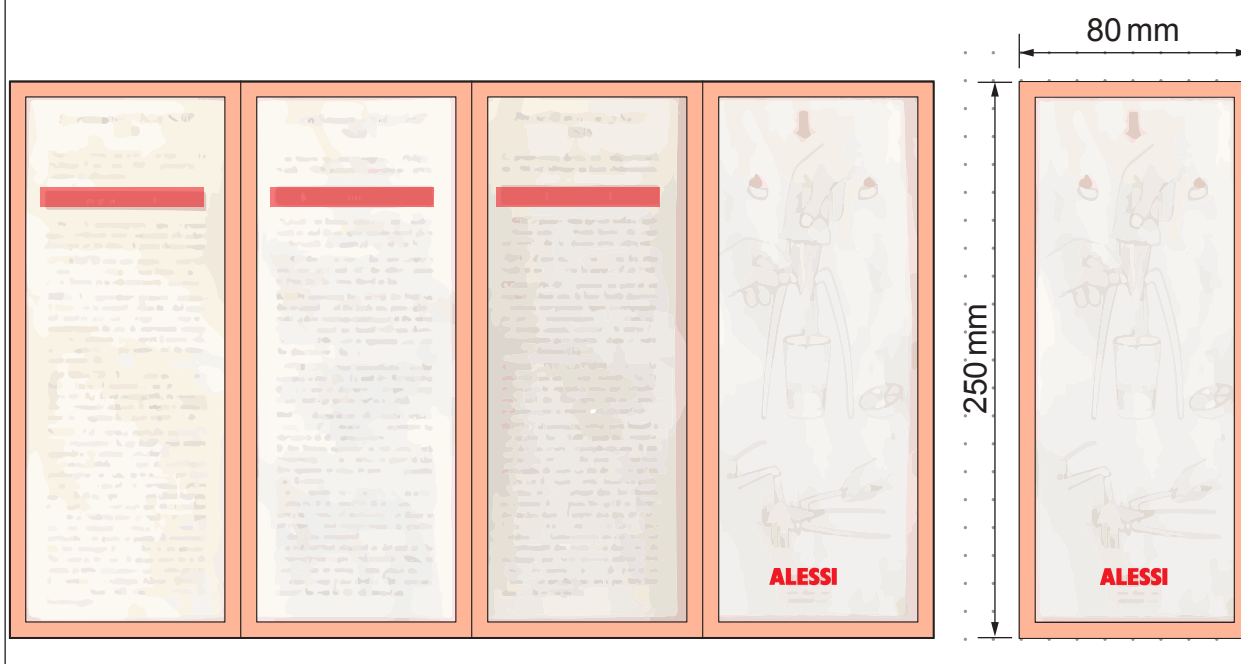
630 mm

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- (ii) The manufacturer decides to print a four-fold leaflet to insert in the packaging. The measurements for the front of the leaflet are shown below.



Calculate how many leaflets can be printed from a sheet that measures
1 metre $\times$ 1 metre.

[3]

Show all workings

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- (c) The packaging is manufactured in an economically developing country. Analyse how a designer can ensure the packaging is produced in an ethical and environmentally friendly way. [5]

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- (d) A prototype of the packaging is tested and evaluated during the process of designing and making.

Evaluate the need for testing and evaluating.

[6]

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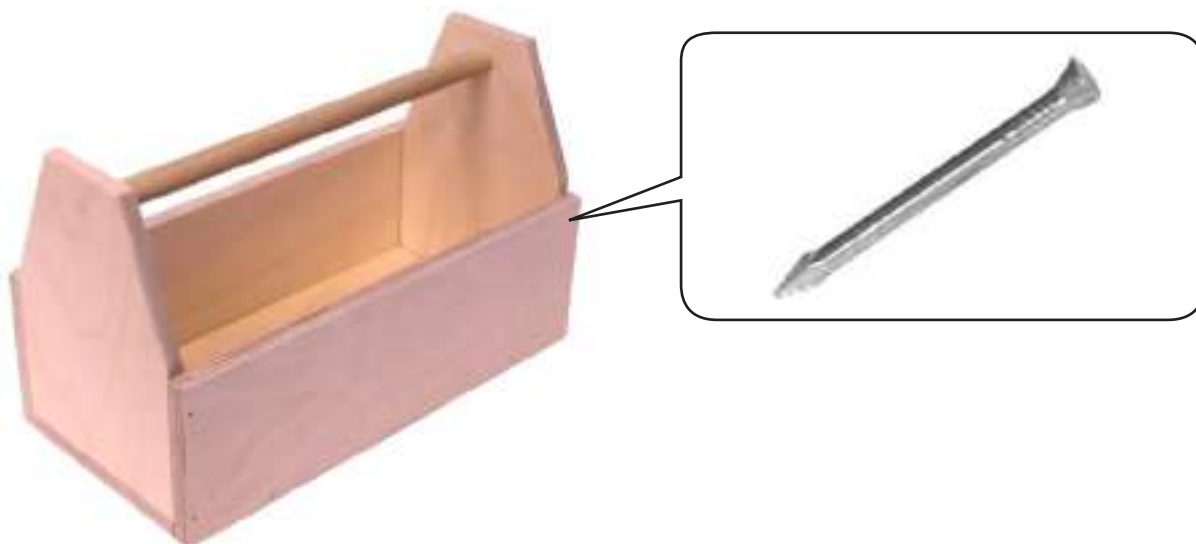
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6. Natural and manufactured timber

(a) The picture below is of a wooden toolbox that has been surface treated.



(i) State a suitable finish used to protect the toolbox. [1]

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(ii) Identify the material used to create the panels of the toolbox. [1]

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(iii) The toolbox is constructed using pins and glue. Explain why pins and glue are used in the construction of the toolbox. [2]

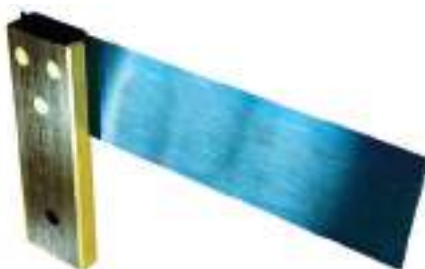
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- (iv) The image below shows a piece of equipment used to mark out the panels of the toolbox.



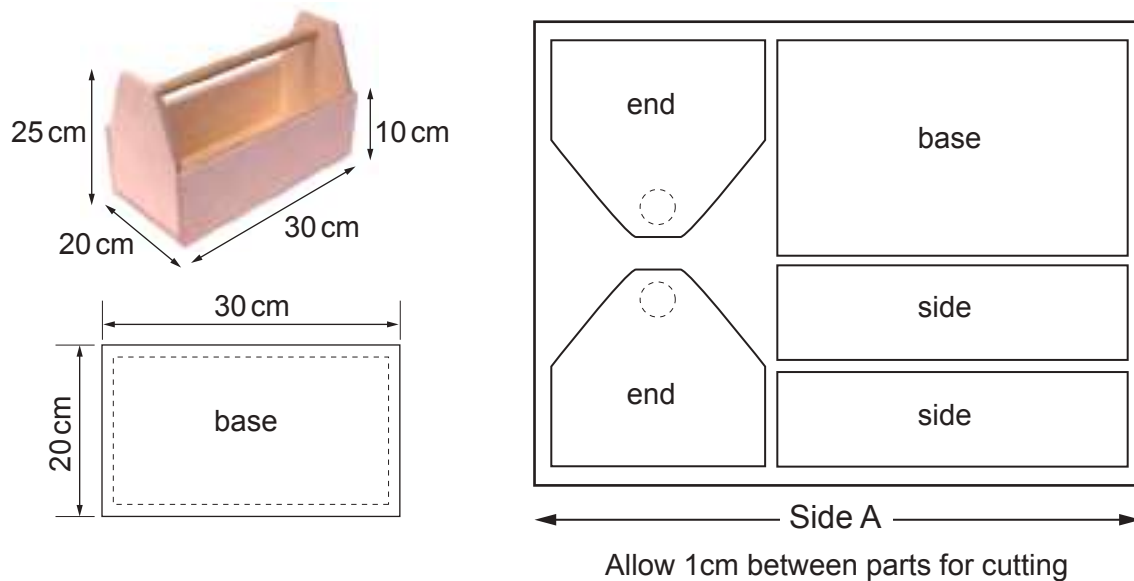
State the name of the piece of equipment shown.

[1]

- (v) When the toolbox is unsuitable for use, it will be recycled. In the space below, use words and sketches to show how the toolbox can be cut and finished to create a simple bird box. [4]



- (b) Measurements for the toolbox are shown below with the plan of the templates used to make the panels of the toolbox.



- (i) Calculate the minimum length of Side A to manufacture **one** toolbox. Select the correct answer by circling **one** of the measurements provided below. Show all workings. [2]

53 cm

60 cm

63 cm

75 cm

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- (ii) The manufacturer cuts the toolbox **base** from a different thickness of material. Calculate how many bases can be cut from a standard sized sheet that measures $244 \text{ cm} \times 122 \text{ cm}$. Show all workings. [3]

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- (c) The toolbox is a low-cost product manufactured in an economically developing country. Analyse how a designer can ensure the toolbox is produced in an ethical and environmentally friendly way. [5]

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- (d) A prototype toolbox is tested and evaluated during the process of designing and making. Evaluate the need for testing and evaluating. [6]

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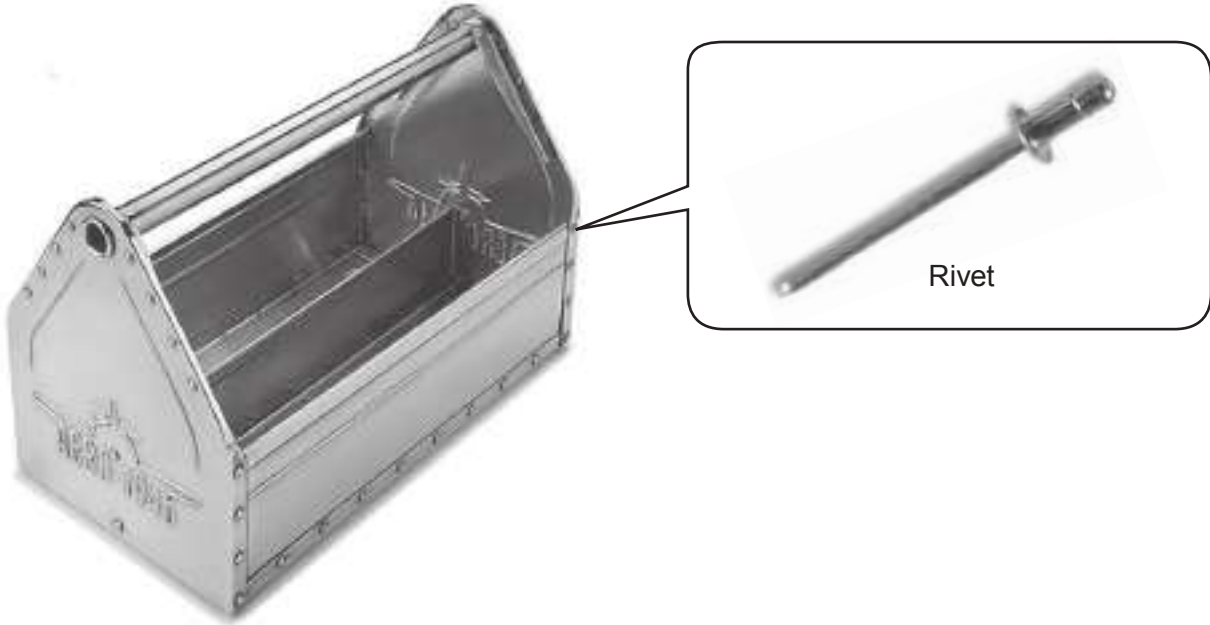
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6. Ferrous and non-ferrous metals

- (a) The picture below is of a toolbox that has been fabricated from mild steel.



- (i) State a surface treatment used to create a suitable finish on the toolbox. [1]

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- (ii) Identify the process that has been used to create the panels of the toolbox. [1]

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- (iii) The toolbox is constructed using rivets. Explain why rivets are used in the construction of the toolbox. [2]

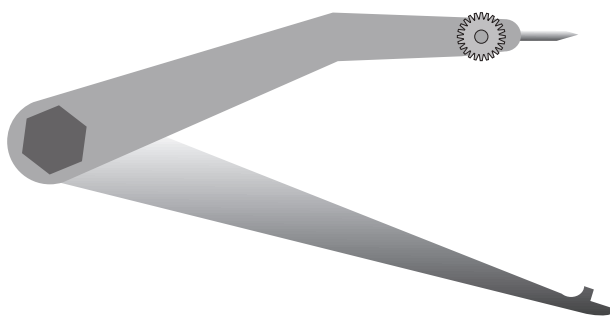
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- (iv) The image below shows a piece of equipment used to mark out the panels of the toolbox.



State the name of the piece of equipment shown.

[1]

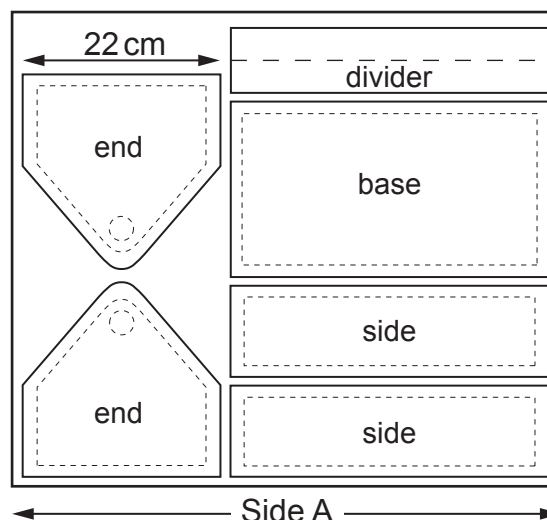
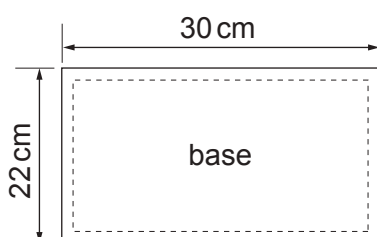
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- (v) The toolbox requires several holes to be drilled for the panels to be riveted. In the space below, use notes and sketches to design a suitable drilling jig. [4]



- (b) Measurements for the toolbox are shown below with the plan of the templates used to make the panels of the toolbox.



- (i) Calculate the minimum length of Side A needed to manufacture **one** toolbox. Select your final correct answer by circling **one** of the measurements provided below. Show all workings. [2]

54 cm

55 cm

70 cm

74 cm

- (ii) The manufacturer cuts the toolbox **base** from a separate sheet of mild steel. Calculate how many bases can be cut from a sheet of mild steel that measures $244\text{ cm} \times 122\text{ cm}$. Show all workings. [3]



- (c) The toolbox is a low-cost product manufactured in an economically developing country. Analyse how a designer can ensure the toolbox is produced in an ethical and environmentally friendly way. [5]

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- (d) A prototype toolbox is tested and evaluated during the process of designing and making. Evaluate the need for testing and evaluating. [6]

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6. Thermosetting and thermoforming plastics

(a) The picture below is of a Rubik's Edge puzzle.



(i) State the reason why Polythene is used to manufacture the Rubik's Edge puzzle. [1]

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The image below shows the nylon flexible ball joints used to connect the Rubik's Edge puzzle.



(ii) Identify a property of nylon that makes it suitable for a flexible ball joint. [1]

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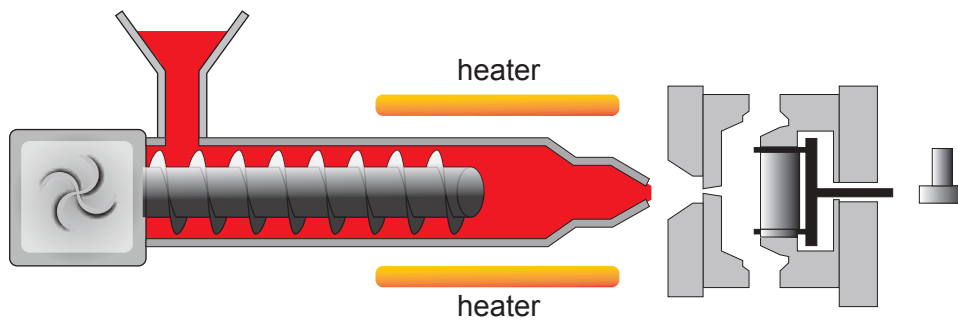
- (iii) Explain why the Rubik's Edge puzzle was designed with flexible ball joints. [2]

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- (iv) The image below shows an industrial piece of equipment used to manufacture the main parts of the Rubik's Edge puzzle.



State the name of this piece of equipment.

[1]

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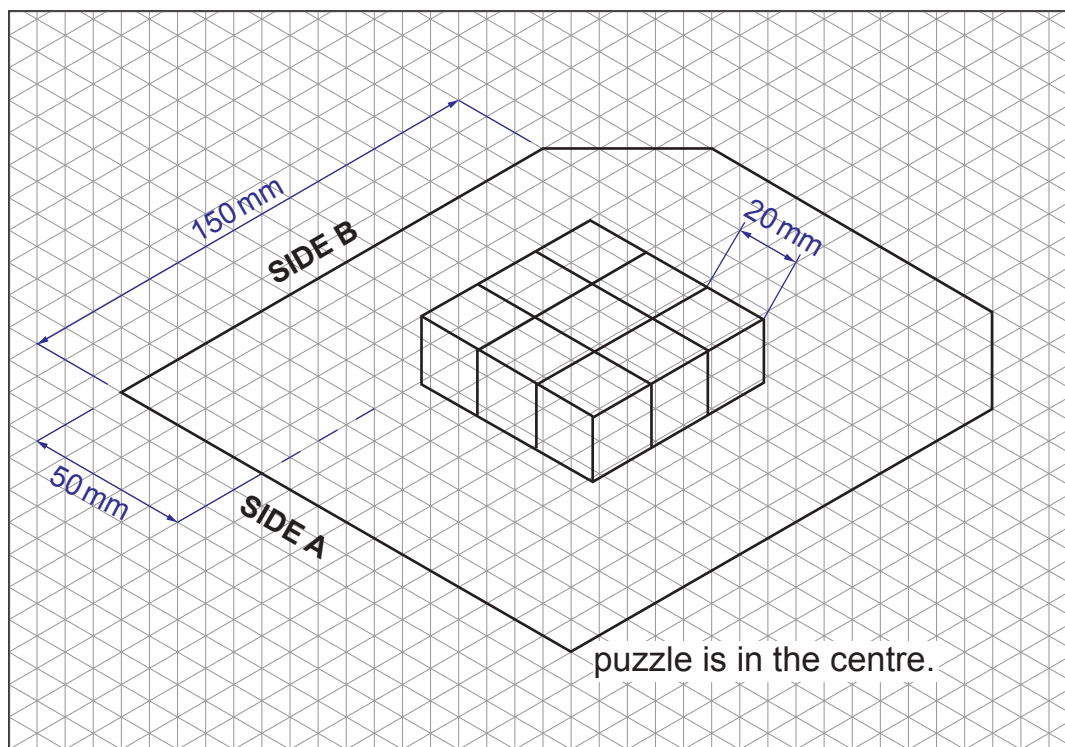
- (v) A vacuum forming technique is used to manufacture blister packaging for the Rubik's Edge puzzle.

In the space below, use words and sketches to design a simple mould for the blister packaging.

[4]



- (b) Measurements of a display stand for the Rubik's Edge puzzle are shown below.



**Diagram not
drawn to scale**

- (i) Calculate the minimum length of material needed for **Side A** of the display stand. Select the final correct answer by circling **one** of the measurements provided below. Show all workings. [2]

120 mm

160 mm

140 mm

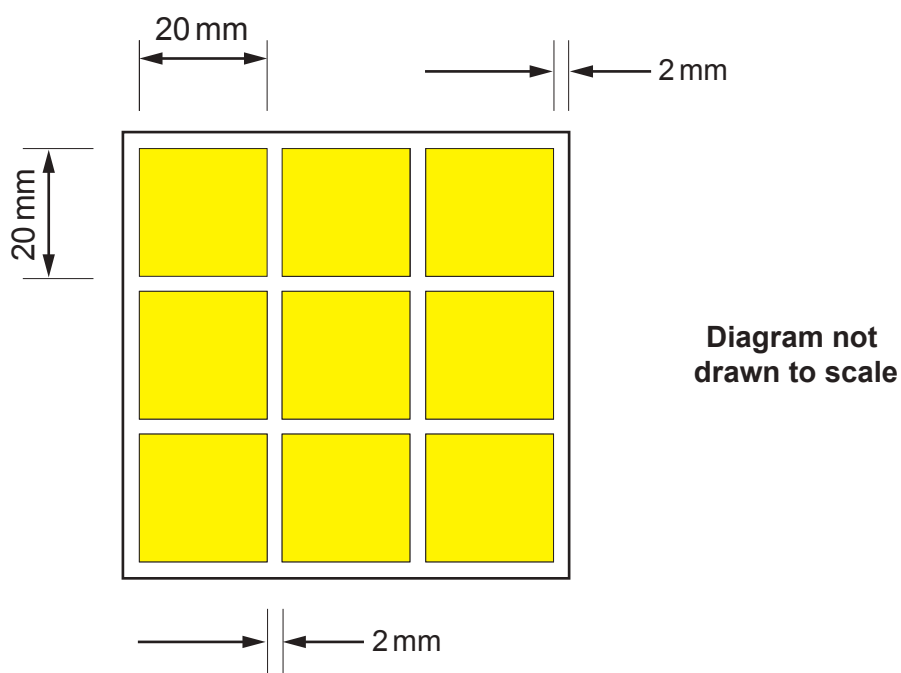
200 mm

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- (ii) The Rubik's Edge puzzle uses a set of stickers as shown in the image below.



Calculate how many sticker sets can be printed and cut from a length of vinyl that measures $200\text{ cm} \times 90\text{ cm}$.
Show all workings.

[3]

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- (c) The Rubik's Edge puzzle is manufactured in an economically developing country. Analyse how a designer can ensure the Rubik's Edge puzzle is produced in an ethical and environmentally friendly way. [5]

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- (d) A prototype of The Rubik's Edge puzzle is tested and evaluated during the process of designing and making.

Evaluate the need for testing and evaluating.

[6]

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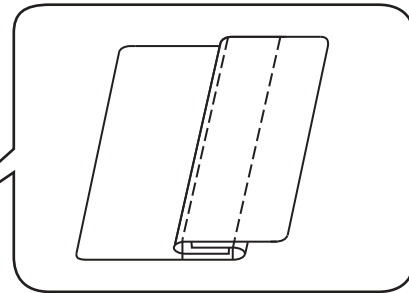
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6. Fibres and textiles

- (a) The picture below is of a t-shirt dyed using a resist method.



flat-fell seam

- (i) State the resist method used to create the dyed pattern effect on the t-shirt. [1]

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- (ii) Identify what has been used to resist the dye's absorption. [1]

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- (iii) The t-shirt is sewn using Flat-fell seams. Explain why Flat-fell seams are used in the construction of the t-shirt. [2]

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- (iv) The image below shows a piece of textile equipment used to cut the fabric of the t-shirt.



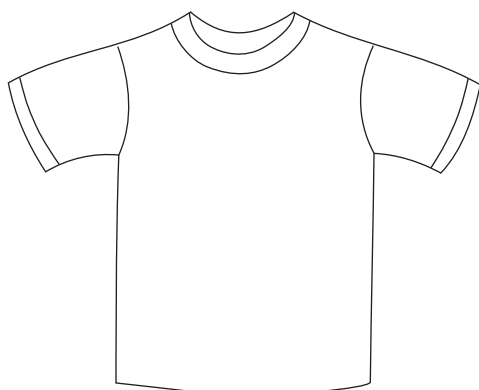
State the name of the equipment.

[1]

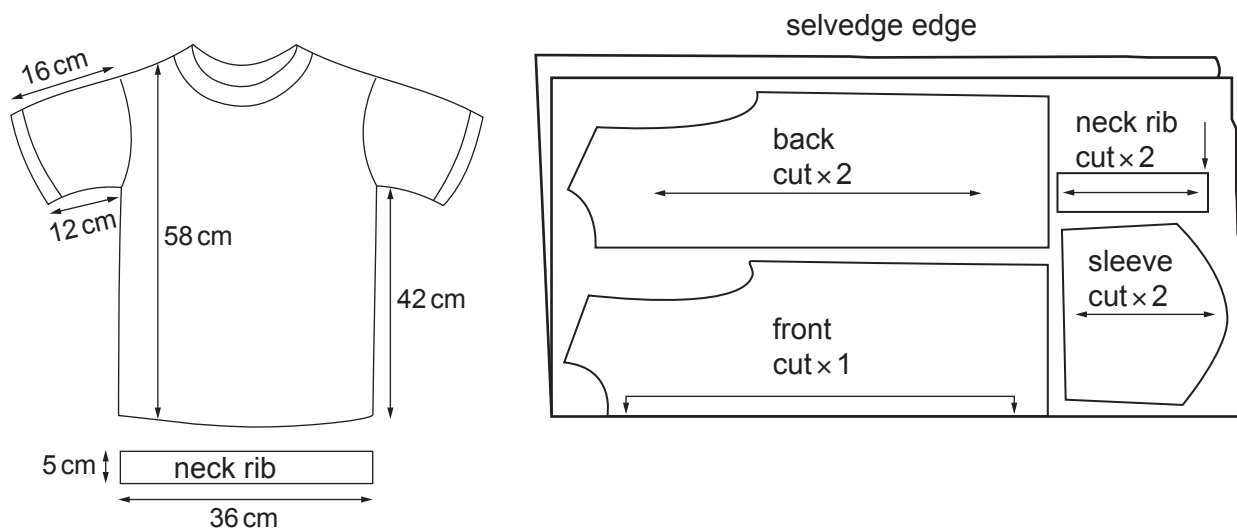
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- (v) When the t-shirt is unsuitable for wear, it will be reused. In the space below, use words and sketches to show how the t-shirt can be cut and sewn to create a simple shopping bag.

[4]



- (b) Measurements for the t-shirt are shown below along with the lay plan of the templates used to make the t-shirt.



- (i) Calculate the minimum length of material needed to manufacture **one** t-shirt. Select your final answer by circling **one** of the measurements provided below. Show all workings. [2]

54 cm

58 cm

70 cm

74 cm

- (ii) The manufacturer decides to cut the neck rib from a separate piece of fabric. Calculate how many pattern pieces can be cut from a length of fabric that measures 200 cm × 90 cm. Show all workings. [3]



- (c) The t-shirt is a high fashion product manufactured in an economically developing country. Analyse how a designer can ensure the t-shirt is produced in an ethical and environmentally friendly way. [5]

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- (d) A prototype of the t-shirt is tested and evaluated during the process of designing and making.

Evaluate the need for testing and evaluating.

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