

Surname	Centre Number	Candidate Number
First name(s)		0



GCSE

C600U10-1



THURSDAY, 12 NOVEMBER 2020 – AFTERNOON

DESIGN AND TECHNOLOGY
Component 1
DESIGN AND TECHNOLOGY IN THE 21st CENTURY

2 hours

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

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ADDITIONAL MATERIALS

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

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

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

Answer questions 1 to 5 and **ONLY ONE** question 6.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

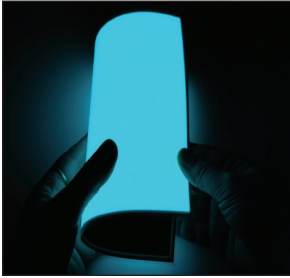
The number of marks is given in brackets at the end of each question or part-question. If you run out of space, use the continuation page at the back of the booklet, taking care to number the question(s) correctly.

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

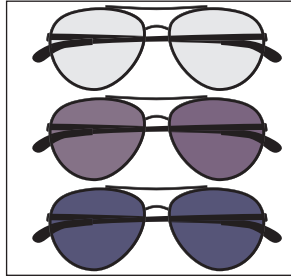
SECTION A*Answer all questions.*

This question is about smart and technical materials.

1. (a) The pictures below are examples of products that use smart materials.



Electroluminescent film



Photochromic glasses



Thermochromic baby spoons

- (i) Define a smart material.

[2]

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- (ii) A retailer sells packs of thermochromic baby spoons. The table below identifies the price of each pack sold.

Quantity	Price
Pack of 1	£0.95
Pack of 3	£2.25
Pack of 10	£4.50

Calculate the saving a consumer would make per spoon if they purchased a pack of three. [2]

Show all workings.

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- (iii) Calculate the percentage (%) saved per spoon if the consumer purchased a pack of ten. [2]

Show all workings.

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- (b) (i) Explain why electroluminescent films are beginning to replace traditional LCD (Liquid Crystal Display) screens in products such as calculators. [2]

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- (ii) Using an example of a named fabric, describe the basic principles of biomimicry. [2]

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This question is about energy and the impact of new technologies on our society.

2. (a) (i) Name **one** of the renewable energy sources shown in the picture below. [1]



Name of energy source:

- (ii) Describe **one** disadvantage of using renewable energy sources to provide heat to households. [2]

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- (b) The demand for electric cars has increased. Explain **one** benefit of buying an electric car. [2]



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(c) The pictures below are examples of wind-up energy products.



Describe the limitations of using these products.

[2]

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(d) Using an example, analyse how technological advances are having a negative impact on our society. [3]

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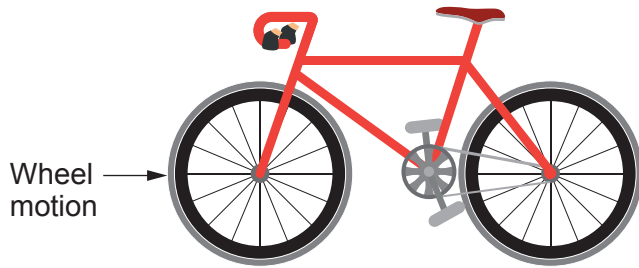
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This question is about electronic systems, programmable components and mechanical devices.

3. (a) Study the products below.

(i) Identify the type of mechanical motion used by **each** product. 2 × [1]



Motion:

Motion:

(ii) Explain how **one** of the mechanical motions in (i) above functions. [2]

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(b) (i) The rider of a bicycle turns the pedal crank 36 times in 30 seconds.
 Calculate the speed of the pedal crank in rpm (revolutions per minute). [2]

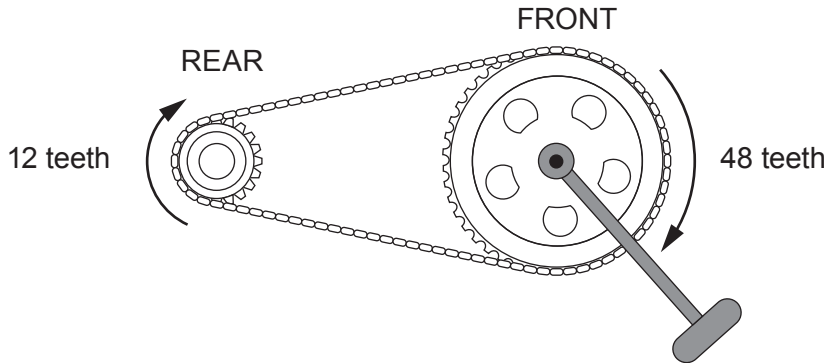
Show all workings.

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(ii) The diagram below shows a gear system used on a bicycle.



Calculate the ratio of the gears used on the bicycle.

[2]

Show all workings.

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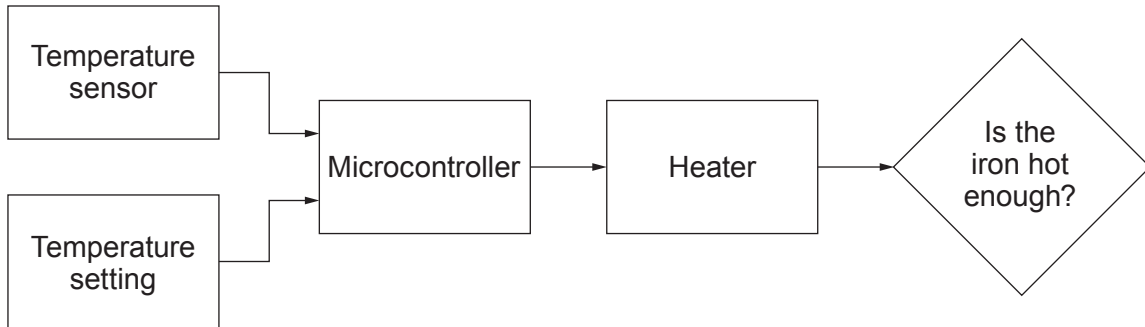
(iii) Using the word bank below, correctly complete the statement that follows:

Fulcrum Force Lever Load

The handbrake on a bicycle is a and the point at which the brake handle pivots is a

[2]

(c) The system diagram below is for an electrical iron. Precise control of an electrical iron is achieved through feedback.



(i) Draw the feedback route for the iron on the systems diagram above. [1]

(ii) The iron uses a thermistor. Describe the function of a thermistor when the iron is in use. [2]

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(iii) Most irons use a light emitting diode (LED) as an output signal. Explain **two** benefits of using LEDs in a product. [2]

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This question is about materials.

4. (a) The images below show different disposable products made from a thermoforming plastic.



- (i) State a thermoforming plastic that could be used for the products shown above.

[1]

- (ii) Thermoforming plastics are sold in many different forms. Name **one** example. [1]

- (iii) Acrylic is a plastic commonly used in design and make projects. Describe the benefits of using this plastic. [2]

(b) The image below is of a tablet stand in use.



(i) State the most appropriate non-ferrous metal to make the tablet stand. [1]

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(ii) Discuss the properties of the material stated in (i) above that make it suitable for the tablet stand. [3]

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(c) The pictures below show a range of products made from denim fabric.



(i) State the main fibre content of denim fabric. [1]

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(ii) State another fibre that is often blended with the fibre stated in (i) above to improve the flexibility of denim. [1]

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(iii) Discuss the reasons why denim is such a versatile material in the construction of products. [6]

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(d) Below is a picture of a child's pop-up book.



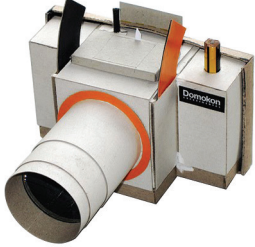


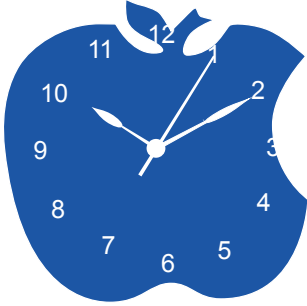


(i) Name the most suitable type of paper used to manufacture this book. [1]

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(ii) Many children's books need to be laminated to improve their aesthetic and functional qualities. Explain the benefits of laminating books for children's use. [3]

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5. Carefully study the images below and 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.

		
<p><i>Child's paper camera kit.</i></p> <input type="checkbox"/>	<p><i>Child's fabric dinosaur toy.</i></p> <input type="checkbox"/>	<p><i>Child's metal toy car.</i></p> <input type="checkbox"/>
		
<p><i>Acrylic clock for a child's bedroom.</i></p> <input type="checkbox"/>	<p><i>Child's mechanical toy.</i></p> <input type="checkbox"/>	<p><i>Child's wooden jigsaw.</i></p> <input type="checkbox"/>

(a) (i) Name **one** finishing or decorative technique that could be used to improve the aesthetic of your chosen product. [1]

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(ii) A laser cutter can be used to cut the material of your chosen product. [3]

Explain the advantages of using a laser cutter.

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(b) Designers need to consider a range of factors when creating new products.

(i) State **one** safety factor considered when designing your chosen product. [1]

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(ii) Apart from safety, describe other factors considered by the designer of your chosen product. [4]

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(c) Consumers are protected by law if products purchased are faulty or not fit for purpose.

(i) State **one** legislative act that protects the buyer when a product is found to be faulty. [1]

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(ii) Evaluate how legislative acts protect the buyer or user. [5]

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- (d) A website company has analysed the total number of sales of the children's products for the month of November. The results are shown in the table below.

Product	Number of Sales
Paper camera	750
Dinosaur toy	4,000
Metal toy car	1,000
Acrylic clock	3,250
Mechanical toy	1,500
Wooden jigsaw	2,000

- (i) State which product had the highest number of sales. [1]

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- (ii) Calculate the total number of products sold. [1]

Show all workings.

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- (iii) In the space below, draw and label a bar chart that displays the information provided in the table. [3]

SECTION B: OPTIONAL QUESTIONS

Choose **ONE** topic area only.

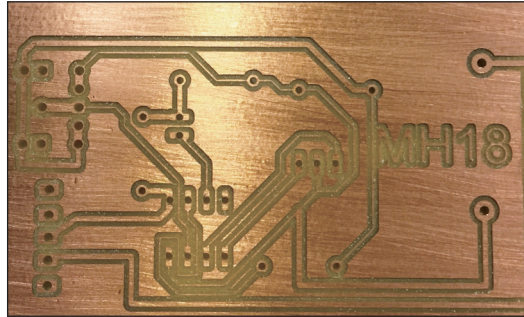
Place a tick (✓) in **one** of the boxes below, to show which topic you are answering.

		Pages
Electronic systems, programmable components and mechanical devices	<input type="checkbox"/>	18-21
Papers and boards	<input type="checkbox"/>	22-25
Natural and manufactured timber	<input type="checkbox"/>	26-29
Ferrous and non-ferrous metals	<input type="checkbox"/>	30-33
Thermosetting and thermoforming plastics	<input type="checkbox"/>	34-37
Fibres and textiles	<input type="checkbox"/>	38-41

Now answer all parts of your chosen topic.

SECTION B**6. Electronic systems, programmable components and mechanical devices**

(a) The picture below is of an unpopulated printed circuit board used in school.



(i) State a chemical process used to produce a printed circuit board. [1]

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(ii) State the name of the material used to make the conductive tracks on the circuit board. [1]

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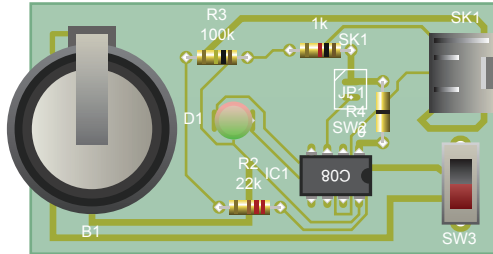
(iii) A batch of 80 circuit boards are manufactured in school. Explain the importance of using a jig to help the drilling process. [2]

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- (iv) The diagram below is a programmable circuit drawn using computer software.



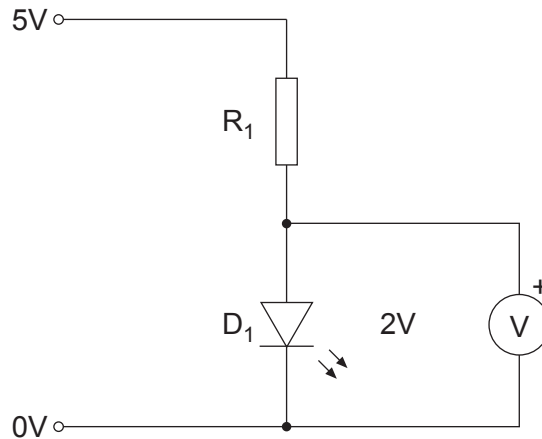
State the name of a suitable computer software package that could have been used to design the circuit. [1]

- (v) Choose any **two** components from the circuit board above and describe their function.

Component	Function
<p>.....</p>	<p>.....</p> <p>.....</p> <p>.....</p> <p style="text-align: right;">[2]</p>
<p>.....</p>	<p>.....</p> <p>.....</p> <p>.....</p> <p style="text-align: right;">[2]</p>

(b) The image below shows a prototype circuit designed by a student.

- (i) The current I , flowing through resistor R_1 , is 10 mA. Calculate the correct resistor value to enable the LED to switch on. $V = I \times R$. *Show all workings.* [2]



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- (ii) There are 38 holes to be drilled through a printed circuit board. The diameter of the drill bit used is 1.5 mm.

Calculate the amount of waste as a result of the drilling. [3]

Show all workings.

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(c) Visual inspections detect faults when populating and soldering components onto a printed circuit board (PCB). Analyse a range of possible faults that could occur when populating and soldering components and suggest how they can be overcome. [5]

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(d) Evaluate the impact James Dyson has had on the design industry. [6]

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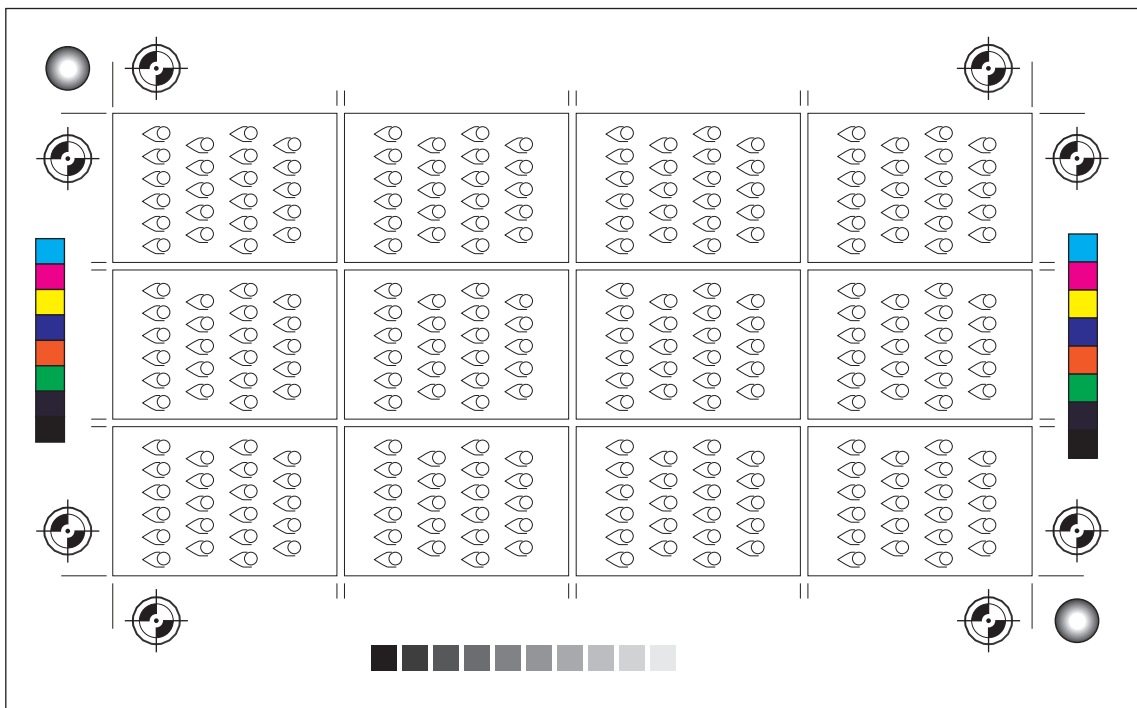
6. Papers and boards

- (a) The images below show an innovative business card designed for a cheese manufacturer. The product is card-based, with a thin layer of metallic finished plastic bonded to its face.



- (i) State the name of the process used to bond the plastic to the card. [1]
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- (ii) Give **one** reason why the card has the plastic bonded to its face. [1]
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- (iii) Die cutting was the finishing process used to create the holes in the business card. Describe the process of die cutting as a finishing technique. [2]
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- (iv) The illustration below shows quality control markings on a business card printing plate.



Underline the word given to the process used to put a document into the correct order before printing. [1]

Imposition Duplex Proof-reading

- (v) Choose **two** of the quality control markings from the illustration above and describe their importance to the printing process.

Quality control marking	Importance to the printing process
<p>.....</p>	<p>.....</p> <p>.....</p> <p>.....</p> <p>[2]</p>
<p>.....</p>	<p>.....</p> <p>.....</p> <p>.....</p> <p>[2]</p>

(b) (i) Complete the table to give the correct sizes for a sheet of A3 paper.

[2]

ISO paper size	Paper dimensions
A4	210 mm × 297 mm
A3 ×
A2	420 mm × 594 mm

(ii) A standard business card is 55 mm × 85 mm. Calculate how many business cards could be printed on **one** A2 sheet of material. [3]

Show all workings.

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- (c) Analyse the benefits of using natural cards from sustainable sources instead of laminated cards and boards when manufacturing card-based products. [5]

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- (d) Environmental concerns have meant recycled papers and boards are being used to manufacture products that traditionally have used plastic.

Evaluate the disadvantages of this shift in manufacturing practice. [6]

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6. Natural and manufactured timber

(a) The picture below is of an oak veneered desk.



(i) State a surface finish that could be applied to the oak parts of the desk. [1]

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(ii) Give **one** advantage of using oak veneer manufactured board for the top of the desk instead of solid oak. [1]

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(iii) Spray painting a high gloss paint finish onto the drawer fronts will increase the lustre and aesthetic qualities of wood. Describe the process of spray painting gloss paint as a finish on the drawer fronts. [2]

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- (iv) The fitting shown below is used to assemble the drawers.

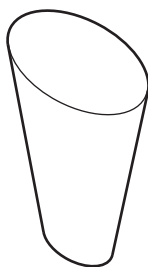


State the name of the fitting used.

[1]

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- (v) The frame of the desk is constructed using a mortise and tenon joint. Sketch a mortise and tenon joint and label its features. [4]

(b) The desk drawers have tapered handles fitted to each drawer front.



(i) How many handles would need to be manufactured if an order was made for 20 desks? [2]

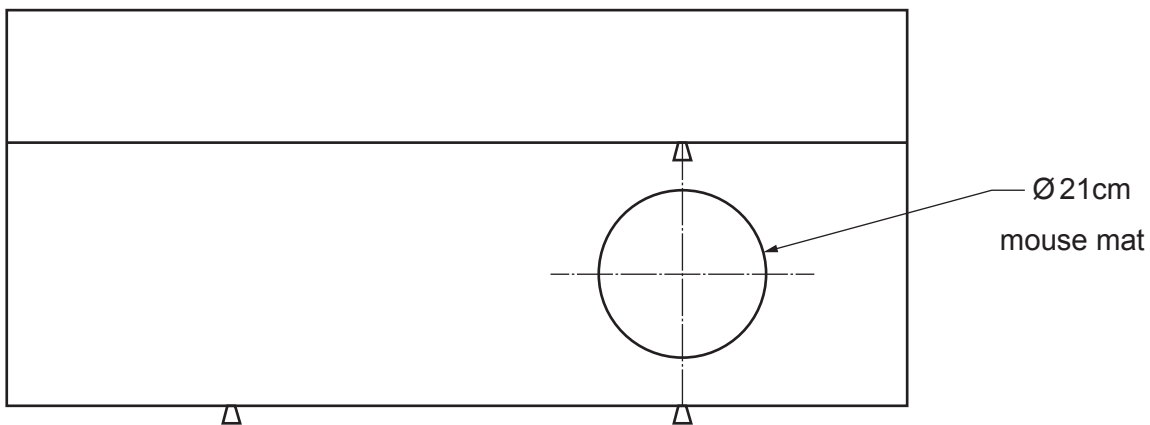
Show all workings.

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(ii) The image below shows a drawing of the desk top with drawer handles and the position of a built-in mouse mat.



The manufacturer of the desk wants to inlay a circular plastic veneer as a mouse mat. Calculate the total area in cm^2 of veneer required for **one** mouse mat, and the total area for a batch of 12. [3]

Show all workings.

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(c) Modern furniture products are often made from man-made boards.

Analyse the benefits of using man-made boards instead of natural solid woods when manufacturing furniture products. [5]

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(d) Evaluate the impact Philippe Starck has had on the product design industry. [6]

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6. Ferrous and non-ferrous metals

- (a) The pictures below are of a glass shelf clamp bracket manufactured from brass with a chrome plated finish.



- (i) State why a chrome plated finish has been applied to the glass shelf clamp bracket. [1]

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- (ii) State a manufacturing process used to create the glass shelf clamp bracket. [1]

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- (iii) Describe the term alloy. [2]

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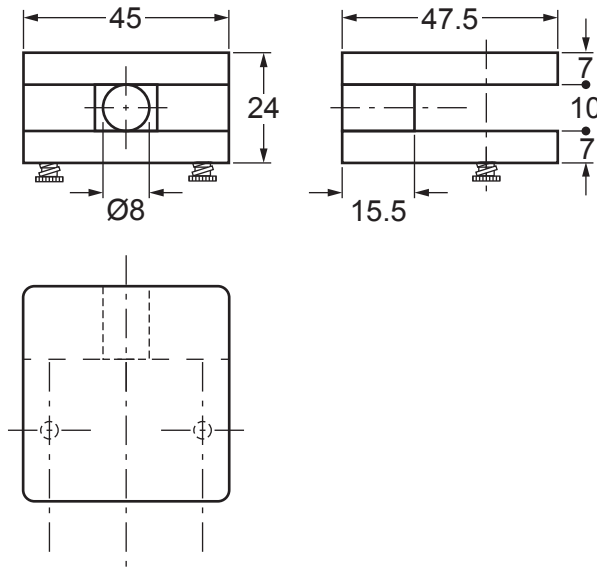
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- (iv) The dimension drawing below is used to aid in the manufacture of the glass shelf clamp bracket.

State the correct name of the type of drawing used.

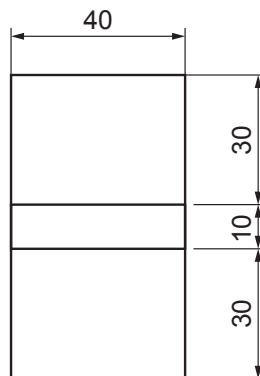
[1]



- (v) Choose **two** drawing details from the working drawing of the shelf clamp bracket above and describe their function.

Feature	Description
<p>.....</p>	<p>.....</p> <p>.....</p> <p>.....</p> <p>[2]</p>
<p>.....</p>	<p>.....</p> <p>.....</p> <p>.....</p> <p>[2]</p>

- (b) (i) The image below shows the template for the rubber insert on the inside of the shelf clamp bracket.



Calculate the area of material required to make the rubber inserts, if an order of 100 shelf clamp brackets was placed. [2]

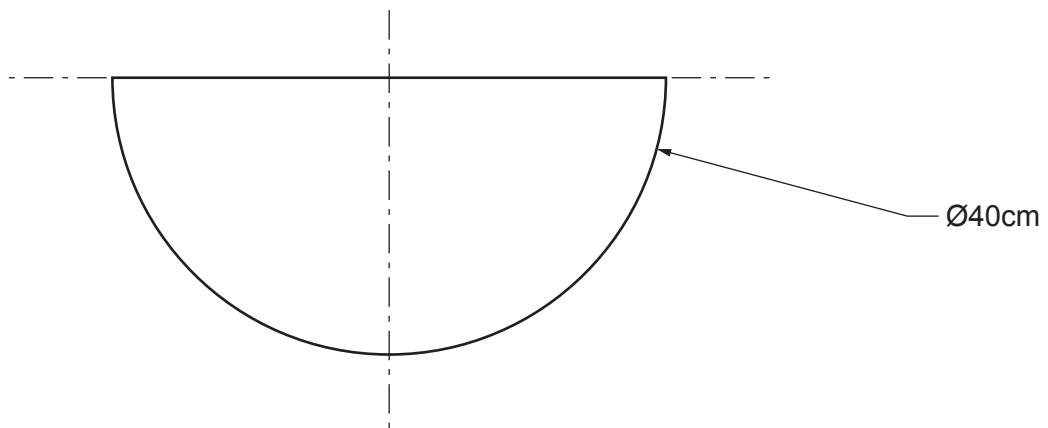
Show all workings.

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- (ii) The image below shows the pattern for a semicircular glass shelf.



Calculate the total area in cm^2 of glass required for **one** shelf, and the total for a batch of 12. [3]

Show all workings.

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(c) Many products in the home are made from non-ferrous metals.

Analyse the benefits of using non-ferrous metals when manufacturing bathroom fittings/products. [5]

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(d) Evaluate the impact James Dyson has had on the product design industry. [6]

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6. Thermosetting and thermoforming plastics

(a) The images below show a game controller for a games console.



- (i) The main body of the game controller has been manufactured using HDPE (High Density Polyethylene) plastic.

State the group of plastics to which HDPE belongs.

[1]

- (ii) State the manufacturing process used to produce the main body of the game controller.

[1]

- (iii) Describe a property of HDPE that makes it suitable material to use in the manufacture of the game controller.

[2]

The image below shows the game controller's joystick. The tip of the joystick has a soft rubberised tip for grip.



(iv) State the name of the process used to create the rubberised finish on the joystick. [1]

(v) Describe the process used to achieve the rubberised finish on the joystick. [4]

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- (b) (i) Calculate the total number of joysticks needed to make 44 game controllers.
Show all workings. [2]

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- (ii) A circular logo of 12 mm diameter is to be formed on the tip of the joystick. Calculate the area of the circular logo. [3]

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(c) Analyse the benefits of using natural plastics instead of synthetic plastics.

[5]

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(d) Evaluate how Apple are changing the way they use plastics in the manufacture of their products.

[6]

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6. Fibres and textiles

(a) The picture below is of a printed dress designed by Matthew Williamson.



(i) State the printing method used to produce the patterned fabric. [1]

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(ii) The fabric used to make the dress was chosen for its high absorbency, handle and lustre. State the fibre used in the construction of the fabric. [1]

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(iii) Calendering is a finishing process that increases the lustre and aesthetic qualities of a fabric. Describe the process of calendering as a finishing technique. [2]

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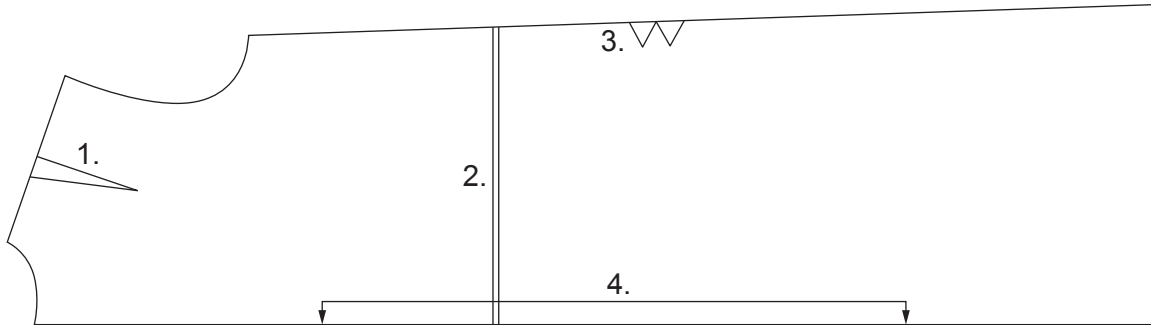
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(iv) The diagram below is a pattern piece for the dress. It shows four common pattern markings.

State the name of the pattern piece shown below.

[1]



(v) Choose **two** pattern markings from the pattern piece above and describe their use in garment construction.

Pattern marking	Function of pattern marking
<p>.....</p>	<p>.....</p> <p>.....</p> <p>.....</p> <p>[2]</p>
<p>.....</p>	<p>.....</p> <p>.....</p> <p>.....</p> <p>[2]</p>

- (b) Matthew Williamson's dress design included flounces sewn to the base of each sleeve.
- (i) Calculate how many flounce pattern pieces would need to be cut from fabric if an order of 12 dresses was made. [2]

Show all workings.

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- (ii) The images below show the pattern piece for a flounce.



The manufacturer of the dress wants to recycle the inner circle of the fabric and use it to make pockets for children's dresses. Calculate the total area in cm^2 of fabric recycled of **one** flounce. [3]

Show all workings.

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(c) Many of Matthew Williamson’s clothes are made from natural materials.

Analyse the benefits of using natural fabrics instead of synthetic fabrics when manufacturing textile products. [5]

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(d) Evaluate the impact Matthew Williamson has had on the fashion and textile industry. [6]

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