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WJEC GCSE Mathematics and Numeracy (Double Award) – Question Pack

Perimeter and area of polygons (rectangle, triangle, trapezium, parallelogram) and circles, plus arc length and sector area as fractions of a full circle

REVISE
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3.12 – Perimeter, area, arcs & sectors

Spec 3.6.1, 3.6.2 – Unit 3 (calculator allowed)

Perimeter and area of polygons (rectangle, triangle, trapezium, parallelogram) and circles, plus arc length and sector area as fractions of a full circle. Sourced from legacy WJEC GCSE Mathematics and Mathematics-Numeracy Higher calculator-allowed papers, organised for revision under the 2025 spec.

2025 SPECIFICATION

Estimated time for entire question pack: ~4 hours 40 minutes

Derived from the GCSE Higher pace of ~1.5 min/mark (187 marks across 38 questions).

*You are advised to **not** attempt to complete all of this in one sitting.*

ABOUT THIS QUESTION PACK

This is a **focused single-topic practice pack**, not a single mock paper. Questions are organised against the 2025 specification. Questions are ordered chronologically by sitting, with custom-written and SAM questions at the end.

INSTRUCTIONS

Use black ink or black ball-point pen. Show all working – method marks are awarded for clear setup.

A calculator is allowed on every question in this pack (Unit 3 is the calculator-allowed paper).

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Perimeter, area, arcs & sectors – what the new spec asks

WJEC GCSE Mathematics (first teaching 2025) · Unit 3: calculator-allowed.

Perimeter & area of polygons 3.6.1

- Rectangle, triangle, parallelogram, trapezium formulas.
- Split composite shapes into pieces; add or subtract as appropriate.
- Quote linear units for perimeter, squared units for area.

Circles, arcs & sectors 3.6.2

- Circumference $C = 2\pi r$ and area $A = \pi r^2$.
- Arc length and sector area are fractions $\theta/360$ of the whole circle.
- Use the π key on the calculator; round only at the final step.

Perimeter, area, arcs & sectors in one page

Quick-reference notes – revisit before each question. Don't use during the questions.

Polygon area formulas

Rectangle: length \times width.

Triangle: $\frac{1}{2} \times$ base \times height.

Parallelogram: base \times perpendicular height.

Trapezium: $\frac{1}{2}(a + b)h$ where a, b are parallel sides.

Circle formulas

$$C = 2\pi r = \pi d \quad A = \pi r^2$$

r is radius, $d = 2r$ is diameter.

Use the calculator's π key for accuracy; round at the very end.

Arc length

$$\text{arc} = \frac{\theta}{360} \times 2\pi r$$

The arc is the fraction $\theta/360$ of the full circumference, where θ is the central angle in degrees.

Sector area

$$\text{sector area} = \frac{\theta}{360} \times \pi r^2$$

The sector is the fraction $\theta/360$ of the full disc area.

For a semicircle ($\theta = 180^\circ$) this halves the disc; for a quarter ($\theta = 90^\circ$) it's a quarter.

Composite shapes

Split the shape into rectangles, triangles, sectors etc.

Compute each piece, then add (or subtract if a hole is cut out).

For perimeter of a composite, add only the *outer* edges.

Perimeter including arcs

Perimeter of a sector = arc + two radii:

$$\frac{\theta}{360}(2\pi r) + 2r.$$

Perimeter of a semicircle = πr (curve) + $2r$ (diameter).

Worked example – sector

Sector of radius 7 cm, angle 40° .

$$\text{Arc} = \frac{40}{360} \times 2\pi(7) \approx 4.89 \text{ cm.}$$

$$\text{Area} = \frac{40}{360} \times \pi(7)^2 \approx 17.10 \text{ cm}^2.$$

Common traps

- Using diameter instead of radius (or vice versa).
- Forgetting to add the two radii when finding a sector perimeter.
- Squared units for area (cm^2), linear units for perimeter (cm).
- Rounding π too early – lose accuracy.

Examiner
only

14. Points E and F lie on a circle, centre O .
The radius of the circle is 10 cm.
The area of the shaded sector is 65 cm^2 .

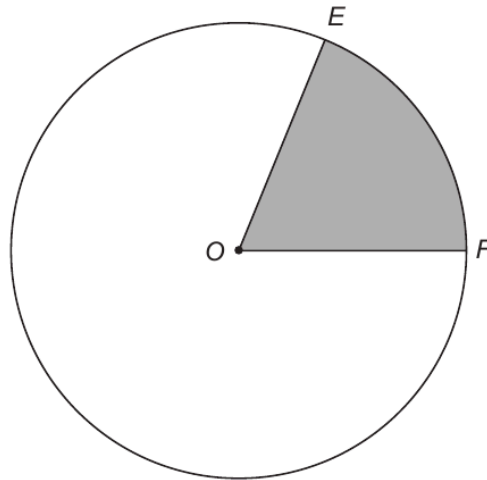


Diagram not drawn to scale

- (a) Calculate the size of $\widehat{EÔF}$. [3]

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- (b) Hence, calculate the length of the arc EF . [2]

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18. A 9-pointed star, with centre O , is shown below.
Each side of the star is of length x cm.

The distance from the centre to every **inner** vertex of the star is 7 cm.
The distance from the centre to every **outer** vertex of the star is 10 cm.

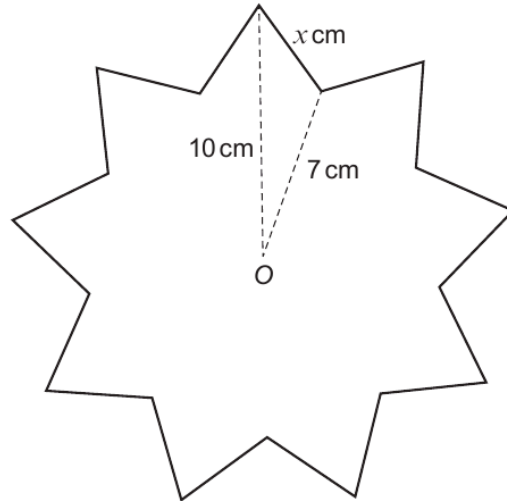


Diagram not drawn to scale

(a) Calculate the perimeter of the star.

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(b) Calculate the area of the star.

[3]

Examiner
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END OF PAPER



Examiner
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3. Bethan builds a rectangular sheep pen.



- (a) The perimeter fence of the sheep pen is 18 m long.
The length of Bethan's sheep pen is two times its width.
Find the length and width of this sheep pen.
You must show your working.

[2]

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Length is metres

Width is metres



Examiner
only

- (b) Bethan decides to build a new sheep pen.
The perimeter fence of the new sheep pen is 16 m long.
The length of the new sheep pen is 3 metres longer than the width.

Form an equation and solve it to find the dimensions of this new sheep pen. [3]

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Length is metres

Width is metres

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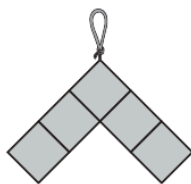
Examiner
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4. Josef has a job in a workshop that makes decorations.

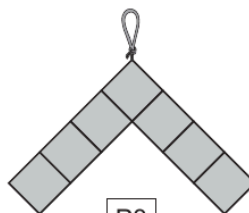
He has made the following three decorations using small squares of stained glass.



P1



P2



P3

Josef labels these patterns P1, P2 and P3 in order.

Josef continues to make decorations following the pattern he has started.

(a) How many **more** squares would he need to make pattern P22 than to make pattern P18? [1]

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(b) Josef has 22 squares.

Josef states,

'I think I can make one complete decoration using **all** 22 squares, with none left over.'

Is Josef correct?

Yes

No

Give a reason for your answer.

[1]

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- (c) Each small square of stained glass measures 0.5 cm by 0.5 cm.
The perimeter of one of Josef's decorations is 10 cm.
Complete the label that Josef would use for this decoration.

[2]

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Examiner
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10. Points A , B and C lie on the circumference of a circle, centre O .
 $\widehat{ACB} = 37^\circ$.

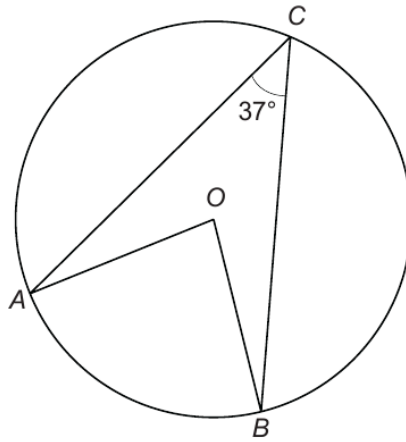


Diagram not drawn to scale

Calculate the size of the **reflex** angle \widehat{AOB} .

[2]

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Examiner
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11



Examiner
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11. A company produces metal badges to be worn by its employees. The badge is made up of two parts. One part is in the shape of a sector of a circle as shown in the diagram.

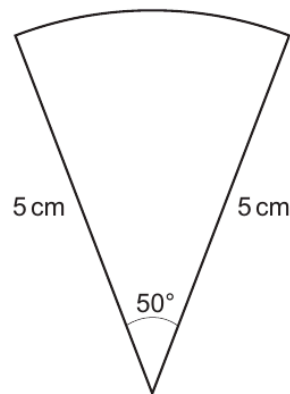


Diagram not drawn to scale

- (a) The perimeter of the sector is decorated with a coloured edging strip. Calculate the length of edging strip needed to decorate the sector.

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- (b) The other part is in the shape of a quarter-circle of radius 3 cm.

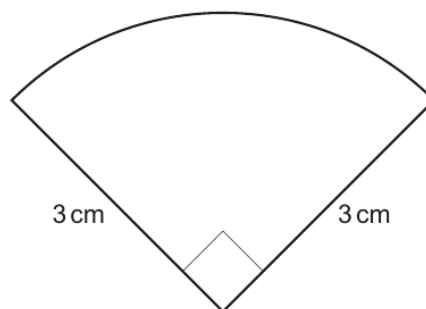


Diagram not drawn to scale



Examiner
only

To make the badge, the two pieces are joined together with the sector in front of the quarter-circle, as shown in the diagram.
The badge has a vertical line of symmetry.

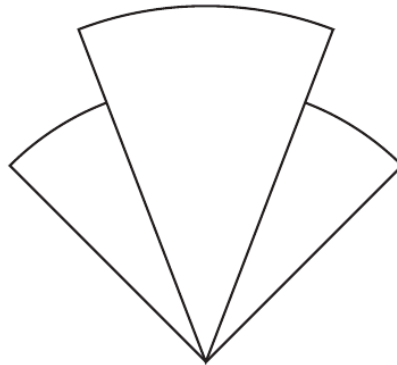


Diagram not drawn to scale

The visible surface of the front of the badge is painted.
Calculate the area that is painted.

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(b) Show that loan's route up this section of road is less steep than Delyth's route.
You must show all your working.

[3]

Examiner
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END OF PAPER



Examiner
only

4. Bethan has a plan of her rectangular lawn, which she has labelled $ABCD$. She wants to cut out a triangular flowerbed from her lawn, labelled GHD . Bethan decides that $AG : GD$ should be $1 : 2$ and that $DH = HC$.

She has made a sketch shown below.

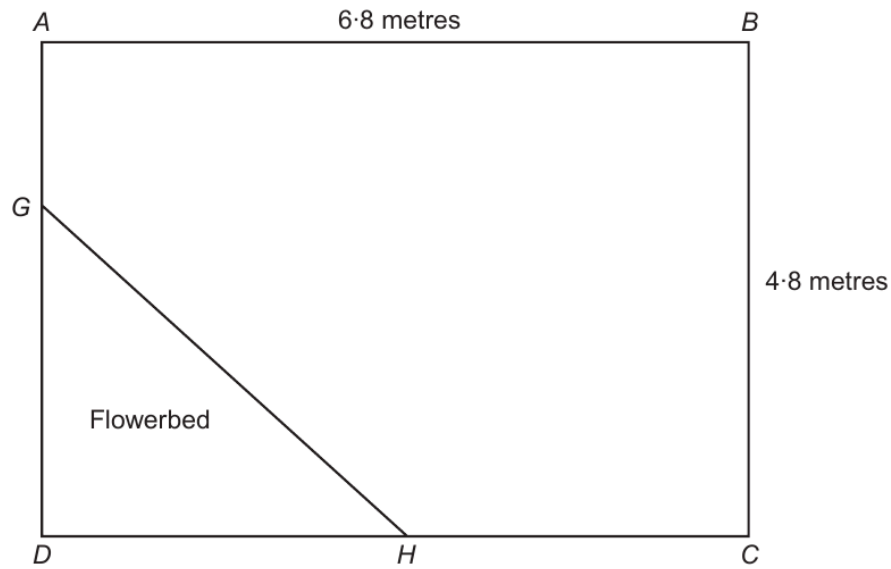


Diagram not drawn to scale

- (a) Calculate the length of GH .

[4]

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14. A and B are points on a circle with centre O .
Calculate the length of the arc AB shown below.

Examiner
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[2]

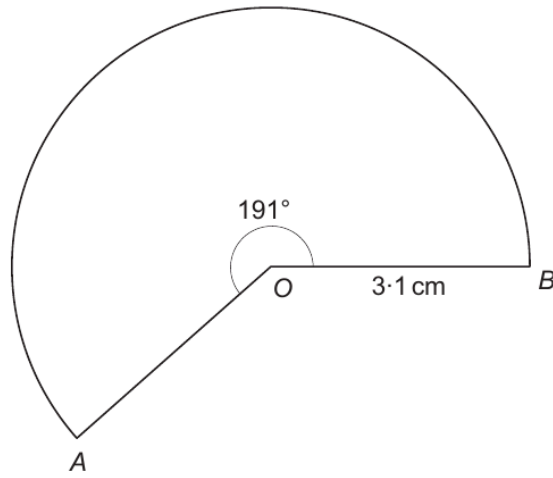


Diagram not drawn to scale

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Examiner only

14. The diagram shows the simplified model of part of an engine. It shows a belt which runs around three circular cogs. The engine rotates Cog 1. Cog 1 rotates the belt, which then makes Cogs 2 and 3 rotate.

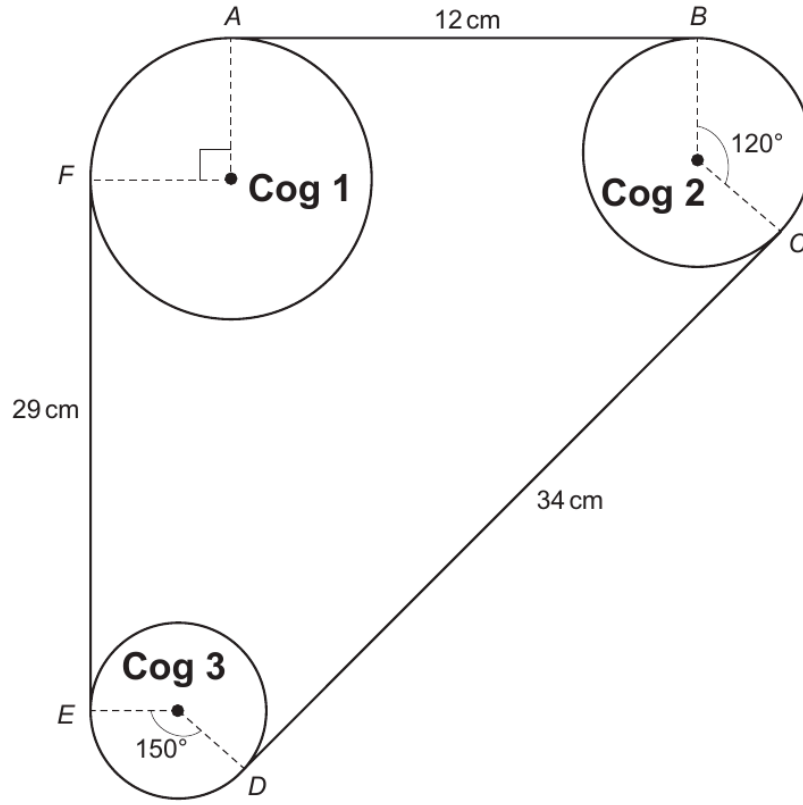


Diagram not drawn to scale

AB , CD and EF are straight sections of the belt.
 $AB = 12$ cm, $CD = 34$ cm and $EF = 29$ cm.
 The belt bends around the outer edges of the circular cogs, represented by the arcs BC , DE and AF .

- The dimensions of the cogs are:
- radius of Cog 1 = 6 cm
 - radius of Cog 2 = 4.5 cm
 - radius of Cog 3 = 3 cm

- (a) What is the length of arc AF in terms of π ?
 Circle your answer.

[1]

2π

3π

6π

4π

$\frac{3\pi}{2}$



Examiner
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- (b) Calculate the total length of the belt.
Give your answer in terms of π in its simplest form.

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Total length of the belt = cm

- (c) Elen notices that when Cog 3 makes two revolutions, Cog 1 makes only one revolution, because the radius of Cog 3 is half the radius of Cog 1.

In one minute, Cog 3 makes 2400 revolutions.

Calculate the number of revolutions **Cog 2** will make in one minute.

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Examiner
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7. In this question, you will be assessed on the quality of your organisation, communication and accuracy in writing.

A, B and C are points on the circumference of a circle with centre O.

$\hat{ACB} = 74^\circ$.

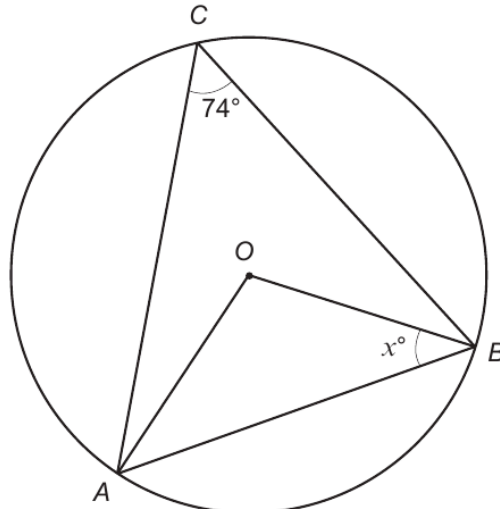


Diagram not drawn to scale

Calculate the value of x .

You must state any angle property of a circle that you use.

You must show all your working.

[4 + 2 OCW]

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Examiner
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1. (a) Write down the n th term of the following sequence. [2]

8, 11, 14, 17,

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(b) Make t the subject of the formula $r = 3t - 8$. [2]

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(c) A rectangle has a length of $(x + 5)$ cm and a width of $(2x - 3)$ cm.
Its perimeter is 46 cm.
Calculate the value of x . [4]

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Examiner
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12. A new athletics stadium is to be built in Alltycapel.

- (a) A throwing circle is to be built for the shot put and discus events. There are lines drawn from the centre of the circle. They show the athletes where the boundaries are for their throws. The lines form a sector of the circle. This sector is to be painted, as shown in the diagram.

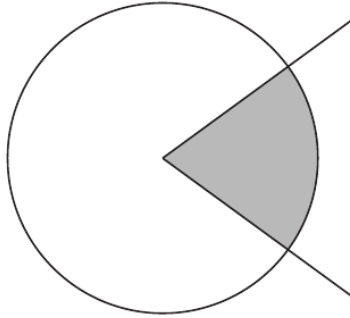


Diagram not drawn to scale

The radius of the throwing circle is 120 cm.

The area of the sector is $0.08\dot{3}$ of the area of the circle.

- (i) Write $0.08\dot{3}$ as a fraction in its simplest form. [3]

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(ii) Use your answer to (i) to calculate the area to be painted.
Give your answer in terms of π in its simplest form.

[2]

Examiner
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Examiner
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(b) A new running track is to be built at the stadium.



Athletes in a 200-metre race run in lanes.
The inside line of one of the lanes is shown below.

The inside line consists of:

- a straight section of length 90 m,
- an arc of a circle with radius 36 m.

The length of this inside line is 200 m.

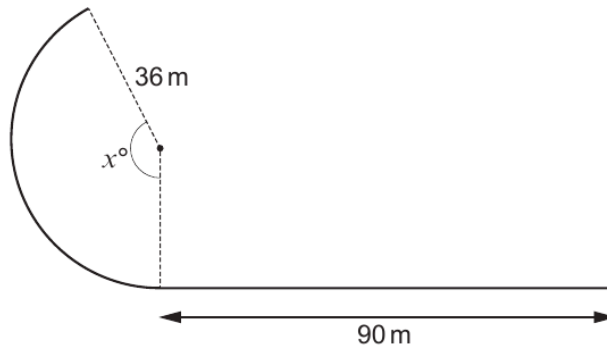


Diagram not drawn to scale

Show that the value of x is $\frac{550}{\pi}$.

[5]

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Examiner
only

14. The diagram shows a triangle ABC and a circle with centre A .
The points B and D lie on the circumference of the circle.

The radius of the circle is 8 cm.
The length of the line AC is 19 cm.
The area of triangle ABC is 70 cm^2 .

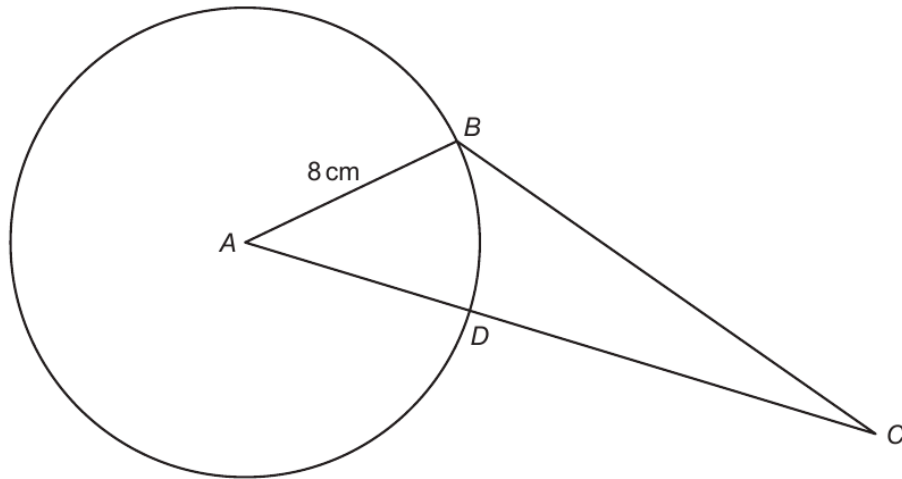


Diagram not drawn to scale

Calculate the area of the sector ABD .

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Examiner only

11. (a) The area of the trapezium $ABCD$ is 25 cm^2 .

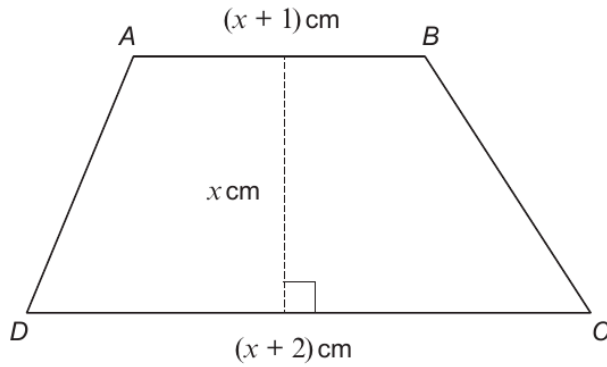


Diagram not drawn to scale

(i) Show that $2x^2 + 3x - 50 = 0$. [3]

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(ii) Solve the equation $2x^2 + 3x - 50 = 0$ to calculate the lengths AB and DC . Give your answers correct to 1 decimal place. [4]

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Length of $AB =$ cm Length of $DC =$ cm



(b) A rhombus has an area of 36.8 cm^2 .
The rhombus is enlarged by a scale factor of 7.
Calculate the area of the enlarged rhombus.

[2]

Examiner
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12. The diagram shows a sector of a circle with centre O and radius 7 cm.
Calculate the perimeter of the sector OAB .

[3]

Examiner
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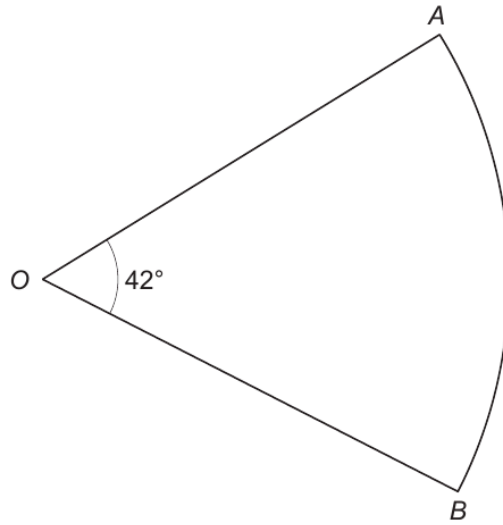


Diagram not drawn to scale

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4. Calculate the total perimeter of a semicircle of radius 4 cm.
Take π to be 3.14.

[3]

Examiner
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Examiner
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9. In this question, you will be assessed on the quality of your organisation, communication and accuracy in writing.

A circle with centre O is shown below.
The radius of the circle is 7.3 cm.

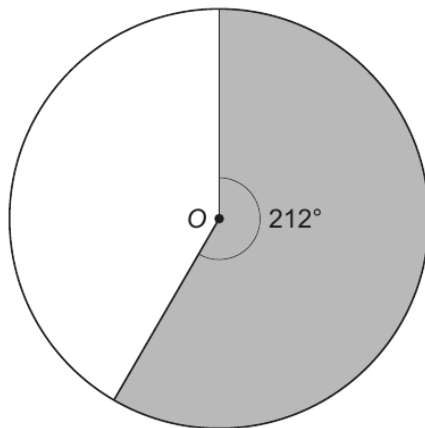


Diagram not drawn to scale

Calculate the perimeter of the shaded region.
You must show all your working.

[3 + 2 OCW]

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Examiner
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11. The diagram shows a triangle ABC and a circle with centre A .
The points B and D lie on the circumference of the circle.

The length of the line AC is 27 cm.
The area of triangle ABC is 112 cm^2 .

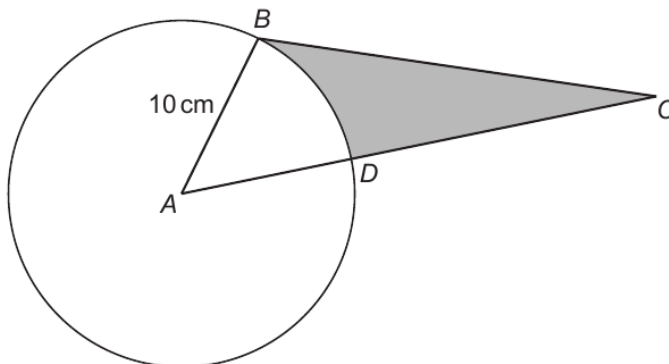


Diagram not
drawn to scale

Calculate the area of the shaded region.

[6]

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Area of shaded region = cm^2



Examiner
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3. A rectangle has a width of $4x - 10$.

(a) Given that x is a whole number, explain why the value of x cannot be less than 3. [1]

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(b) The perimeter of the rectangle is $14x - 4$.

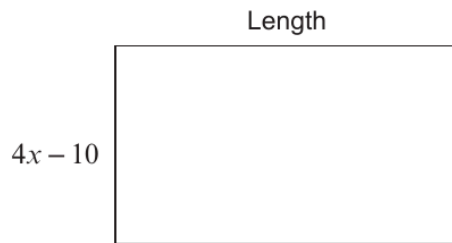


Diagram not drawn to scale

Find the length of the rectangle in **terms of x** . [4]

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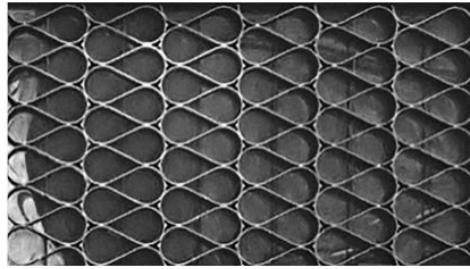
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05



7. Nia saw this bottle rack in her local hotel.



Nia decides to make a smaller bottle rack in the same style.
The front view of her bottle rack is shown below.
Nia made the rack from bending a long sheet of metal.

It has straight sections, each of length 6.6 cm.

It also has curved sections that are all arcs of a circle with radius 4.5 cm and sector angles of 120° or 240° .

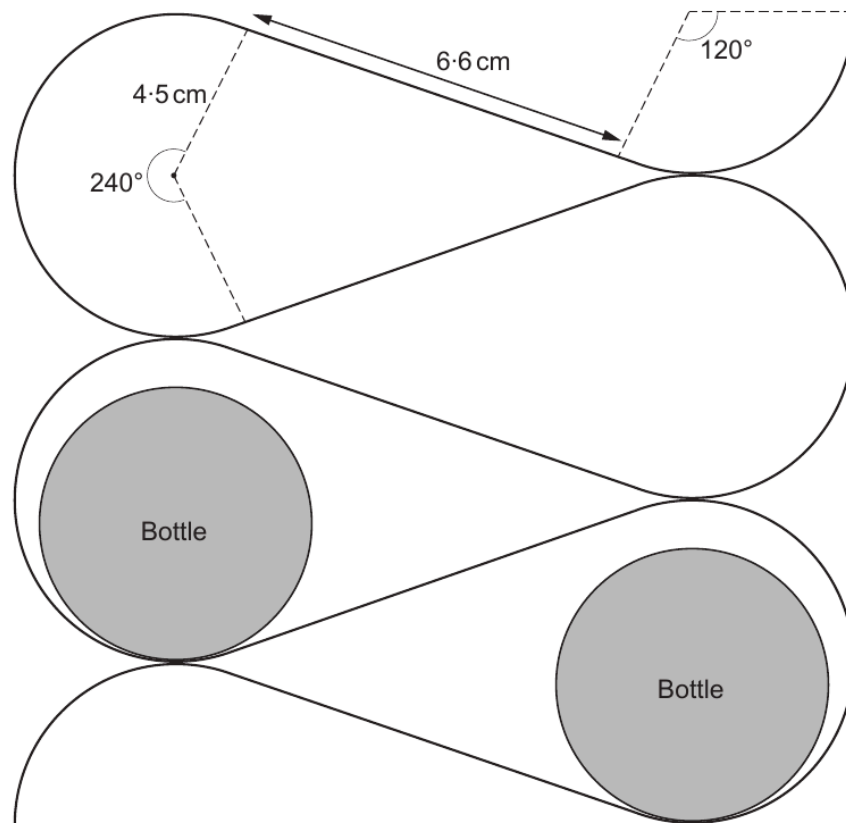


Diagram not drawn to scale



Calculate the length of the sheet of metal that Nia needed for her design.
Give your answer in terms of π , in its simplest form.
You must show all your working.

[5]

Examiner
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Length of metal sheet needed = cm



Examiner only

4. (a) (i) A single tree can absorb 48 **pounds** of carbon dioxide per year.
 Calculate the carbon dioxide absorbed per year by a forest of 440 of these trees.
 Give your answer in **kilograms**. [2]

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Carbon dioxide absorbed per year is kg

(ii) A forest of trees absorbs 2.3×10^{11} grams of carbon dioxide per year.
 Which of the following is 2.3×10^{11} ? Circle your answer. [1]

230 000 000 000 23 000 000 000 2 300 000 000 000

0.000 000 000 0023 0.000 000 000 023

(b)

Remember: $10\,000\text{m}^2 \approx 2.47$ acres
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A report states that a fire in a forest has a high risk of spreading when there are more than 60 trees per acre.

There are 615 trees in Grancwm Forest.
 The forest covers an area of $40\,000\text{m}^2$.

Would a fire in Grancwm Forest have a high risk of spreading?

Yes No

You must show all your working to support your answer. [4]

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Examiner only

- (c) A vertical pine tree stands on horizontal ground. From a point on the ground 21 metres from its base, the angle of elevation of the top of the pine tree is 39° .

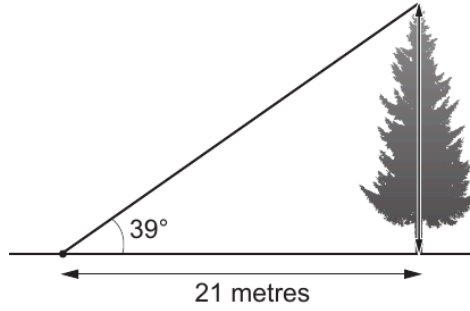


Diagram not drawn to scale

- (i) Show that the pine tree has a vertical height of 17 metres. [3]

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- (ii) A cylindrical log is cut from this pine tree. The **circumference** of the cross-section of the log is 1.75 m. The length of the log is half the height of the tree. Calculate the volume of the log. Give your answer in m^3 . You must show all your working. [5]

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Volume of the log is m^3



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Examiner
only

8. Form-A-Part is a company that makes metal parts for use in engineering.

- (a) A metal part is made from a circular disc with a piece cut out. The part has uniform thickness, a diameter of 60 mm, and centre O. The diagram below shows the cross-section of the metal part.

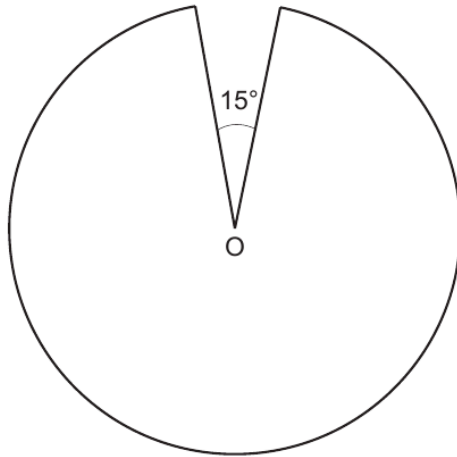


Diagram not drawn to scale

Calculate the perimeter of the cross-section of this metal part.
Give your answer correct to the nearest millimetre.

[3]

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Perimeter of the metal part is mm, correct to the nearest millimetre.



Examiner
only

- (c) Form-A-Part has decided to randomly sample these 20 000 metal parts to check their quality.

Use the following list of random numbers to select the first 5 parts for the sample. You must start with the first number in the list.

Explain clearly how you are using the numbers to select the sample. [3]

66923	01325	58552	86923
48925	72712	58033	18266
95775	51056	01325	81036
05929	10429	26883	45630
88925	24800	02891	38441

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The 5 parts selected will be

1st 2nd 3rd

4th 5th



Examiner only

9. A, B, C and D are points on the circumference of a circle with centre O .

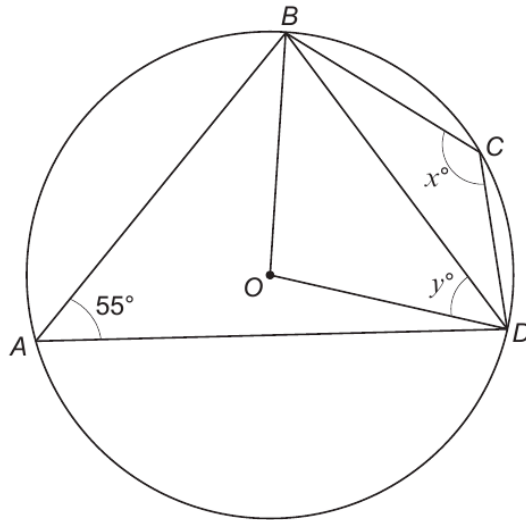


Diagram not drawn to scale

(a) Calculate the value of x .
Circle your answer.

[1]

- 55° 70° 110° 125° 135°

(b) Calculate the value of y .

[3]

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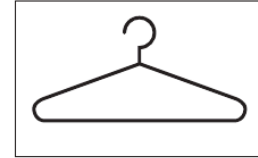
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Examiner only

9. Hang-Up is a company that makes clothes hangers. One type of hanger is made from a single length of metal wire that is bent to form the hanger.



- (a) (i) The design for the main part of the hanger is shown below. This part of the hanger is symmetrical. It has straight sections of length 24 cm and 38 cm. It also has curved sections that are arcs of a circle of radius 3 cm.

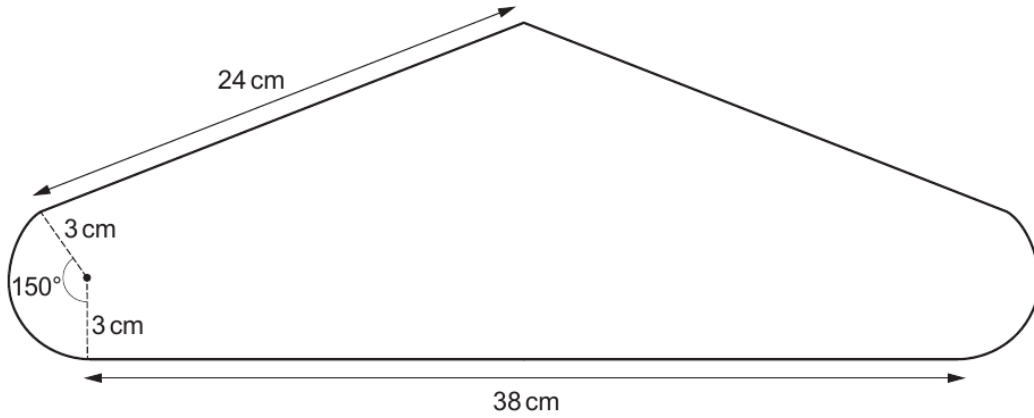


Diagram not drawn to scale

Calculate the length of metal wire needed for the main part of the hanger. Give your answer in terms of π in its simplest form.

[4]

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Examiner
only



- (ii) The length of wire needed for the hooked part of this hanger is $0.1\dot{3}$ of the total length of wire needed for a hanger.

Write $0.1\dot{3}$ as a fraction in its simplest form.

[3]

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- (b) Hang-Up makes metal hangers in batches of 80. Every 3 hours, it randomly samples 8 hangers from one batch of 80 for quality assurance.

The following numbers are taken from a table of random digits.

299986 890791 810130 955579 268884 301244

Use these numbers to choose 8 hangers from a batch of 80 hangers. You must start with the first number in the list. Describe clearly how you use the numbers to select the sample.

[3]

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Hangers chosen:

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Examiner
only

- (c) Hang-Up also makes plastic hangers of various sizes. Two of its plastic hangers have main parts that are mathematically similar. These are shown below.



Diagram not drawn to scale

The total surface area of the larger hanger is 1.44 times the total surface area of the smaller hanger.

The height of the smaller hanger is 9 cm.
Calculate the height of the larger hanger.

[3]

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