Area and perimeter

Understand the measurement before choosing a formula.

1 What are we measuring?

Perimeter is the total distance around a shape’s boundary. Use length units such as mm, cm or m. Area is the amount of surface inside a two-dimensional shape. Use square units such as mm², cm² or m².



Not to scale

For this rectangle: perimeter = 12 + 6 + 12 + 6 = 36 cm; area = 12 × 6 = 72 cm². The numbers measure different things and cannot be compared as if they were the same quantity.

2 Units must match

Convert lengths to the same unit before substituting. A rectangle measuring 1.4 m by 60 cm has area 1.4 × 0.60 = 0.84 m² and perimeter 2(1.4 + 0.60) = 4 m.

1 cm² = 100 mm² • 1 m² = 10 000 cm²

Area conversions use the square of the length conversion factor: 1 m = 100 cm, so 1 m² = 100 × 100 cm². Never multiply by only 100 when converting m² to cm².

3 A reliable method

Identify the required measurement → label known and missing lengths → choose a formula or split the shape → substitute with matching units → calculate → state units and check whether the answer is sensible.

Triangles and quadrilaterals

Use perpendicular height, not a sloping side.

Rectangle: $A = l \times w$; $P = 2(l + w)$

For a square of side s: $A = s^2$ and $P = 4s$.

Triangle: $A = \frac{1}{2}bh$

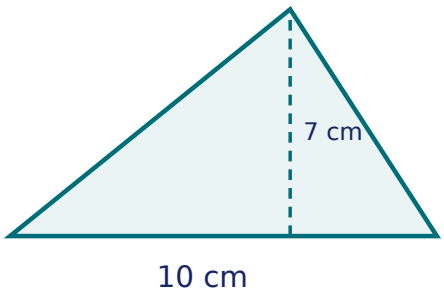
b is the chosen base; h is the height perpendicular to that base.

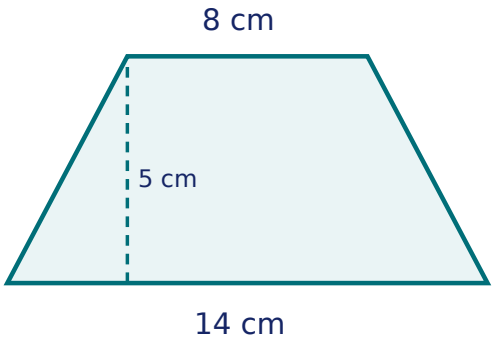
Parallelogram: $A = bh$

For perimeter, add the four side lengths; height is not a side length.

Trapezium: $A = \frac{1}{2}(a + b)h$

a and b are the parallel sides; h is the perpendicular distance between them.





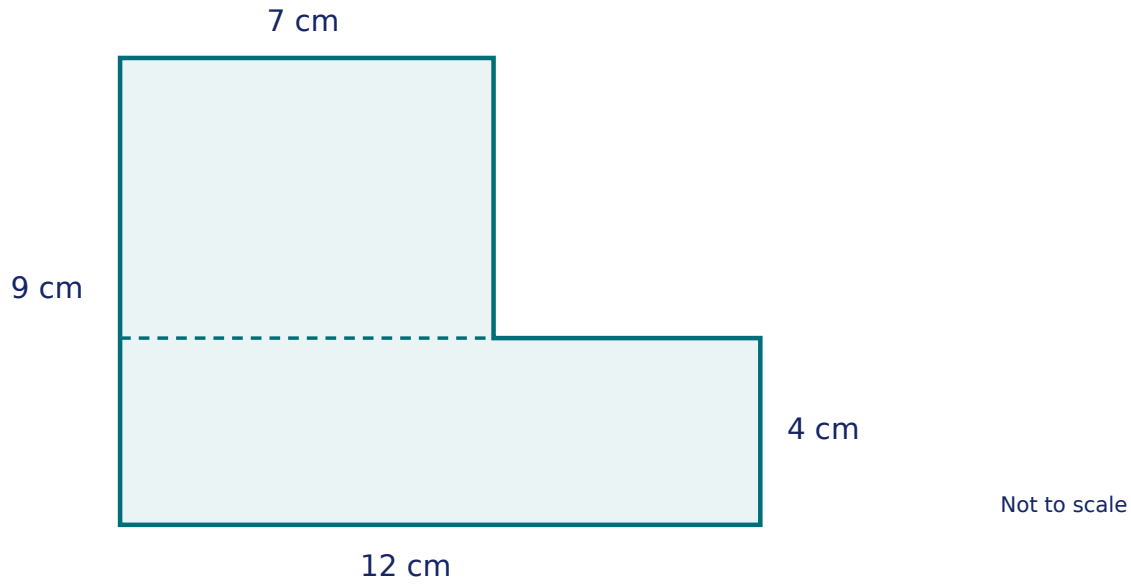
Triangle: $\frac{1}{2} \times 10 \times 7 = 35$ cm².

Trapezium: $\frac{1}{2} \times (8 + 14) \times 5 = 55$ cm².

Extra useful result: a kite or rhombus with perpendicular diagonals d_1 and d_2 has area $\frac{1}{2}d_1d_2$. Do not use this for an arbitrary quadrilateral whose diagonals are not perpendicular.

Compound shapes

Split or subtract areas; trace the outside boundary for perimeter.



Worked example: an L-shaped region

The full width is 12 cm and the full height is 9 cm. The top width is 7 cm and the lower right vertical side is 4 cm. The missing horizontal edge is $12 - 7 = 5$ cm; the missing vertical edge is $9 - 4 = 5$ cm.

Area by splitting: lower rectangle 12×4 plus upper rectangle 7×5 gives $48 + 35 = 83$ cm².

Check by subtracting: enclosing rectangle 12×9 minus the missing corner 5×5 gives $108 - 25 = 83$ cm².

Perimeter: trace all six outside edges: $12 + 4 + 5 + 5 + 7 + 9 = 42$ cm. The dashed dividing line is internal, so it is not part of the perimeter.

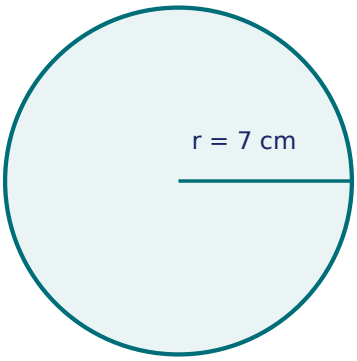
Shaded regions and holes

For a shaded region, subtract the unshaded area from the enclosing area. If a question asks for the total boundary length of a region with a hole, include the boundary around the hole as well. Read the wording carefully.

Common mistake: adding the perimeters of the separate rectangles counts the shared internal edge twice. Adding their areas is valid; adding their perimeters is not.

Circles and semicircles

Keep π in your working and round only at the end.



radius r

diameter d = 2r

Circumference is a circle’s perimeter.

Circle: $A = \pi r^2$ • Circumference: $C = 2\pi r = \pi d$

Example: if r = 7 cm, $A = \pi \times 7^2 = 49\pi$ cm² ≈ 153.94 cm², and $C = 2 \times \pi \times 7 = 14\pi$ cm ≈ 43.98 cm. These decimal answers are to 2 decimal places.

Semicircles: include the straight edge

Semicircle: $A = \frac{1}{2}\pi r^2$ • Perimeter: $P = \pi r + 2r$

For a semicircle with diameter 10 cm, r = 5 cm. Area = $\frac{1}{2} \times \pi \times 5^2 = 12.5\pi$ cm². Perimeter = half the circumference + diameter = 5π + 10 cm ≈ 25.71 cm.

A rectangle joined to a semicircle

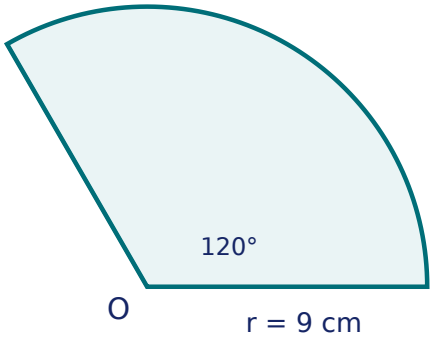
A rectangle is 10 cm long and 6 cm wide. A semicircle is attached along one 6 cm side, so its radius is 3 cm. The shared diameter lies inside the combined shape.

Area: $10 \times 6 + \frac{1}{2}\pi \times 3^2 = 60 + 4.5\pi$ cm².
Perimeter: $10 + 10 + 6 + \pi \times 3 = 26 + 3\pi$ cm.

Exam tip: “Give an exact answer” means retain π. Use the calculator’s π key unless the question explicitly gives an approximation to use.

Sectors and arc lengths

A sector is a fraction of a circle, bounded by two radii and an arc.



The fraction of the full circle is θ/360, where θ is measured in degrees. Use degree mode for trigonometry later in the lesson.

Sector area = (θ/360) × πr²

Arc length = (θ/360) × 2πr

Sector perimeter = arc length + 2r

Worked example: r = 9 cm and θ = 120°

120/360 = 1/3, so this sector is one third of a circle.
Area: (1/3) × π × 9² = 27π cm².
Arc length: (1/3) × 2π × 9 = 6π cm.
Perimeter: 6π + 18 ≈ 36.85 cm (2 d.p.).

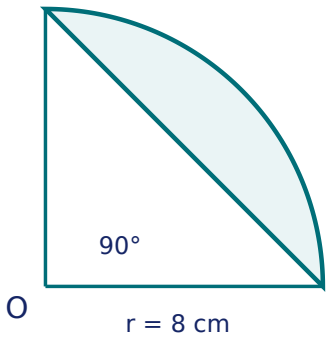
Finding an unknown angle

A sector has radius 12 cm and area 30π cm².
(θ/360) × 144π = 30π → θ = 360 × 30/144 = 75°.

Major sectors: if the minor angle is 80°, the major angle is 360° − 80° = 280°. Use 280° in the formula for the major sector. Arc length alone is not the perimeter of a sector.

Segments and triangle area

Higher extension: connect sector area with trigonometry.



A segment lies between a chord and its arc.
A sector lies between two radii and an arc.
The pale region here is a minor segment.

Triangle area = ½ab sin C

a and b are two sides of a triangle and C is their included angle. For two radii, a = b = r, so the triangle area is ½r² sin θ. This uses the trigonometry skills linked to syllabus Topics 54 and 55.

Minor segment area = (θ/360)πr² − ½r² sin θ

Use the minor central angle, with 0° < θ ≤ 180°. For a major segment, subtract the corresponding minor segment from the full circle.

Worked example: radius 8 cm, angle 90°

Sector: (90/360) × π × 8² = 16π cm².
Triangle: ½ × 8 × 8 × sin 90° = 32 cm².
Minor segment: 16π − 32 cm² ≈ 18.27 cm² (2 d.p.).

Major segment: 64π − (16π − 32) = 48π + 32 cm².

Segment perimeter: add the arc length and the chord, not two radii. Here the chord is √(8² + 8²) = 8√2 cm, so the minor segment perimeter is 4π + 8√2 cm.

Algebra and reverse problems

Form an equation from the measurement you have been given.

Example 1: find a missing height

A trapezium has parallel sides 9 cm and 15 cm and area 84 cm².
84 = ½(9 + 15)h = 12h → h = 7 cm.
Check: ½ × 24 × 7 = 84 cm².

Example 2: a quadratic from a rectangle

A rectangle has width x cm and length (x + 5) cm. Its area is 84 cm².
x(x + 5) = 84 → $x^2 + 5x - 84 = 0$
(x + 12)(x − 7) = 0 → x = −12 or x = 7.
A length must be positive, so width = 7 cm and length = 12 cm.
Perimeter = 2(7 + 12) = 38 cm.

Example 3: area of a ring

Two concentric circles have outer radius 10 cm and inner radius 6 cm. The region between them is an annulus (a ring).

> Ring area = $\pi R^2 - \pi r^2 = \pi(R^2 - r^2)$

Area = π(100 − 36) = 64π cm².
If asked for the total boundary length, add both circumferences: 20π + 12π = 32π cm. The outer perimeter alone is 20π cm.

Checks that prevent lost marks

- A sloping side is not automatically the perpendicular height.
- Square the radius, not the diameter, in πr^2.
- Convert units before forming an equation.
- Reject negative lengths and check the result in the original formula.
- A length scale factor k gives an area scale factor k^2 (Topic 43).
- Do not round intermediate values unless instructed.

Independent practice

Original QLS practice questions. These are not extracted examination questions.

1. A parallelogram has base 13 cm, perpendicular height 6 cm and sloping side 8 cm. Find its area and perimeter.

2. A trapezium has parallel sides 7 cm and 17 cm and area 96 cm². Find its perpendicular height.

3. A 15 cm by 11 cm rectangle has a 6 cm by 4 cm rectangular corner removed. Find the remaining area and perimeter.

4. A semicircle has diameter 14 cm. Find its exact area and exact perimeter.

5. A sector has radius 12 cm and angle 150°. Find its exact area, arc length and perimeter.

6. A circle has radius 10 cm. Find the exact area of the minor segment whose central angle is 60°. Then give a decimal answer to 2 d.p.

7. A rectangle has width x cm and length (x + 3) cm. Its area is 54 cm². Find its dimensions and perimeter.

8. A rectangular floor measures 2.4 m by 175 cm. Find its area in m² and perimeter in metres.

Practice solutions and recap

Check methods as well as final answers.

1. Area = 13 × 6 = 78 cm². Perimeter uses the side length: 2(13 + 8) = 42 cm.

2. 96 = ½(7 + 17)h = 12h, so h = 8 cm.

3. Area = 15 × 11 − 6 × 4 = 141 cm². Removing a corner replaces two outside edge portions with equal lengths, so perimeter = 2(15 + 11) = 52 cm.

4. r = 7 cm. Area = ½π × 49 = 24.5π cm². Perimeter = 7π + 14 cm.

5. 150/360 = 5/12. Area = (5/12)π × 144 = 60π cm². Arc = (5/12) × 24π = 10π cm. Perimeter = 10π + 24 cm.

6. Sector = (60/360)π × 100 = 50π/3. Triangle = ½ × 100 × sin 60° = 25√3. Segment = (50π/3 − 25√3) cm² ≈ 9.06 cm².

7. x(x + 3) = 54 → x² + 3x − 54 = 0 → (x + 9)(x − 6) = 0. Reject −9. Dimensions: 6 cm by 9 cm; perimeter = 30 cm.

8. 175 cm = 1.75 m. Area = 2.4 × 1.75 = 4.2 m². Perimeter = 2(2.4 + 1.75) = 8.3 m.

Lesson checklist

I can choose area and perimeter formulas; find perpendicular heights; split compound shapes; use circle, sector and segment formulas; form equations; give exact answers; and include correct units.

Lesson basis: Edexcel_Mathematics_Syllabus.pdf, Topic 45 “Areas and Perimeters”; topic coverage informed by the two reference images in the Lesson 45 folder. Explanations, examples, practice and diagrams in these notes are newly created. The separate past-paper question and answer documents are not part of this notes PDF.