Cambridge IGCSE · Mathematics 0580 · Notes

Circles, arcs and sectors

Read online at **pastopic.com/cambridge/mathematics-0580/notes/circles-arcs-and-sectors**

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Read first: **Geometrical terms and symmetry**, **Units, area and perimeter**

What you need to know

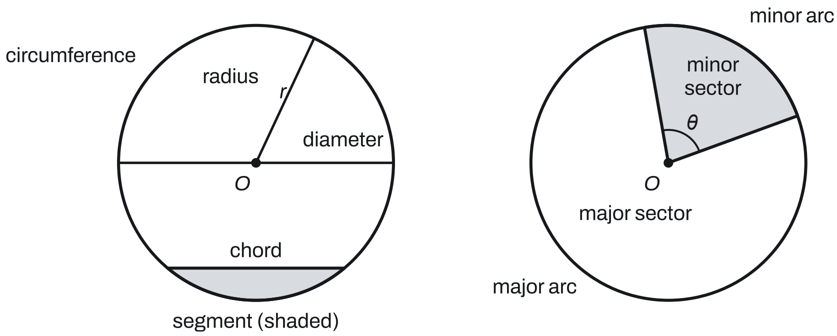
By the end of this topic you should be able to:

1. **Work out the circumference and the area of a circle**, from its radius or its diameter, and work backwards from a circumference or an area to the radius or diameter. Give answers as decimals or, when asked, **in terms of** π (such as 64π).
2. **Work out arc lengths and sector areas as fractions of a circle**: an arc is a fraction of the circumference and a sector is the same fraction of the area, the fraction being the sector angle out of 360°. On Core papers the sector angle divides exactly into 360° (such as 45°, 60°, 72° or 120°).
3. **Extended only:** work with any sector angle, and with **major** sectors and arcs as well as minor ones, including finding an unknown angle or radius.
4. **Work out perimeters and areas of compound shapes and parts of shapes that include circles**, such as semicircles, quarter circles, a circle cut out of a rectangle, and (**Extended only**) a segment cut off by a chord.

The words radius, diameter, chord, arc, sector and segment come from Geometrical terms. Straight-sided shapes (rectangles, triangles, trapeziums) are in Units, area and perimeter; cylinders, cones and spheres are in Surface area and volume.

Understand it

The parts of a circle



diameter d = 2r

angles: θ and 360° – θ

- The **radius** r goes from the centre to the edge. The **diameter** d goes right across through the centre, so $d = 2r$.
- The **circumference** is the distance all the way round: the circle's perimeter.
- An **arc** is part of the circumference. A **sector** is the "pizza slice" between two radii and an arc. The smaller one is the **minor** sector (angle θ) and the rest of the circle is the **major** sector (angle $360^\circ - \theta$).
- A **chord** is a straight line joining two points on the circle. It cuts the circle into two **segments**.

Circumference

For every circle, the circumference divided by the diameter is the same number, a little more than 3. That number is called π ("pi"), $3.14159\ldots$. So

$$C = \pi d = 2\pi r.$$

A circle of radius 5 cm has circumference $2 \times \pi \times 5 = 10\pi = 31.4$ cm (3 s.f.). Use the π key on your calculator (or 3.142), not 3.14 or $\frac{22}{7}$, which are not accurate enough for the answer mark.

Working backwards. If you know the circumference, divide by 2π to get the radius: $C = 40$ cm gives $r = \dfrac{40}{2\pi} = 6.37$ cm.

Wheels. One full turn of a wheel moves it forward by one circumference. The number of turns is the distance divided by the circumference, with both in the same units.

Area

Cut a circle into many thin sectors and lay them top to tail. They make a shape close to a rectangle whose height is r and whose length is half the circumference, πr. So the area is $\pi r \times r$:

$$A = \pi r^2.$$

Square the radius first, then multiply by π. A circle of radius 5 cm has area $\pi \times 5^2 = 25\pi = 78.5$ cm². If you are given the diameter, halve it first: diameter 18 gives $r = 9$ and $A = 81\pi$.

Working backwards. Divide by π, then square root: area 50 cm² gives $r^2 = \dfrac{50}{\pi} = 15.9\ldots$, so $r = 3.99$ cm.

Answers in terms of π

"In terms of π" means leave π as a letter: 25π, not 78.5. Simplify the number in front: $\frac{45}{360} \times \pi \times 8^2 = \frac{1}{8} \times 64\pi = 8\pi$. A perimeter can mix π and plain numbers, such as $16 + 8\pi$; you cannot add these together.

On the non-calculator Papers 1 and 2, keeping π as a letter is how you get an exact answer.

Arcs and sectors are fractions of the circle

A sector with angle θ is the fraction $\dfrac{\theta}{360}$ of the whole circle. Its arc is that fraction of the circumference, and its area is that fraction of the circle's area:

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

A 90° sector is a **quarter circle** ($\frac{90}{360} = \frac{1}{4}$) and a 180° sector is a **semicircle** ($\frac{1}{2}$). For a sector of radius 6 cm and angle 120°: the fraction is $\frac{120}{360} = \frac{1}{3}$, so the arc is $\frac{1}{3} \times 12\pi = 4\pi$ cm and the area is $\frac{1}{3} \times 36\pi = 12\pi$ cm².

The perimeter of a sector is the arc **plus the two radii**: $4\pi + 12$ cm for that sector. The perimeter of a semicircle of radius r is $\pi r + 2r$ (half the circumference plus the diameter).

Extended only: major sectors. A major sector has angle $360^\circ - \theta$. If the minor sector angle is 70°, the major sector angle is 290°, and its arc is $\frac{290}{360}$ of the circumference. You can also find the minor one and take it away from the whole circle.

Finding an angle or a radius. Put the numbers you know into the formula and solve. An arc of 5π cm on a circle of radius 9 cm: $\frac{\theta}{360} \times 18\pi = 5\pi$, so $\frac{\theta}{360} = \frac{5}{18}$ and $\theta = 100^\circ$.

Compound shapes with curves

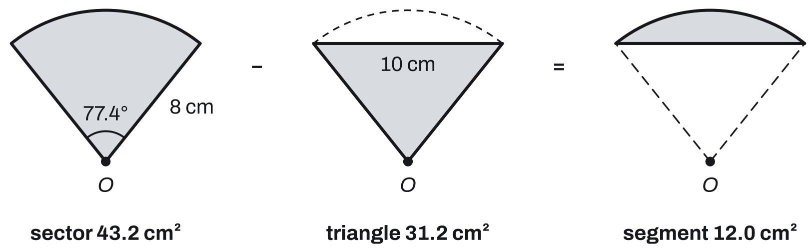
Treat a shape made from rectangles, triangles and parts of circles the same way as any compound shape:

- **Area**: add the pieces, or take the whole shape and subtract the holes (for example, a square minus a quarter circle, or a rectangle minus several circles).
- **Perimeter**: go round the outside once, adding the straight edges and the arcs. A line where two pieces join is **inside** the shape and does not count. In the window in Example 3, the diameter of the semicircle is not part of the perimeter.
- **Percentage shaded** $= \dfrac{\text{shaded area}}{\text{whole area}} \times 100.$

Look for lengths the diagram gives you in disguise: circles that touch the sides of a square have diameter equal to the square's side; a circle through the corners of a square has the square's diagonal as its diameter.

Extended only: segments

A **segment** is the part between a chord and an arc. The minor segment is the sector with the triangle OAB taken away:



The triangle has two sides equal to r with angle θ between them, so its area is $\frac{1}{2}r^2 \sin\theta$ (the "$\frac{1}{2}ab\sin C$" formula from trigonometry):

$$\text{minor segment} = \frac{\theta}{360} \times \pi r^2 - \frac{1}{2}r^2 \sin\theta.$$

A **major segment** is the major sector **plus** the same triangle (or the whole circle minus the minor segment). The perimeter of a segment is the arc plus the chord. If you only know the chord, find θ first: the line from O to the middle of the chord makes two right-angled triangles, so $\sin\frac{\theta}{2} = \dfrac{\text{half the chord}}{r}$.

Key facts and formulas

"Given" means it is on the List of formulas printed on page 2 of every 0580 paper (Core and Extended). "Learn it" means you must remember it.

Formula	Status
Circumference $C = 2\pi r$	Given
Area of a circle $A = \pi r^2$	Given
$d = 2r$, so $C = \pi d$	Learn it
Arc length $= \dfrac{\theta}{360} \times 2\pi r$	Learn it
Sector area $= \dfrac{\theta}{360} \times \pi r^2$	Learn it
Perimeter of a sector $=$ arc $+2r$; semicircle $= \pi r + 2r$	Learn it
Major sector angle $= 360^\circ -$ minor sector angle	Learn it
Radius from circumference $r = \dfrac{C}{2\pi}$; from area $r = \sqrt{\dfrac{A}{\pi}}$	Learn it

Formula	Status
Number of turns of a wheel $= \dfrac{\text{distance}}{\text{circumference}}$	Learn it
Extended: triangle area $= \frac{1}{2}ab\sin C$	Given
Extended: minor segment $=$ sector $- \frac{1}{2}r^2\sin\theta$; major segment $=$ major sector $+ \frac{1}{2}r^2\sin\theta$	Learn it

Use π from your calculator or 3.142.

How to do it

In the questions we have tagged for this topic (68 questions, 67 different, 2021–2025), the types came up this often. 11 of the 67 different questions mix two or more types, so the counts add up to more than 67.

Question type	Questions
Circumference and area of a circle	23
Arc length and the perimeter of a sector	19
Compound shapes and shaded regions with circles	17
Area of a sector	12
Segments (Extended)	5
Sectors that make cones (Extended)	3

1. Circumference and area of a circle (23 questions)

1. **Get the radius.** If you are given the diameter, halve it.
2. **Choose the formula**: circumference $2\pi r$ (a length round the edge), area πr^2 (space inside). Both are on the formula list.
3. **Substitute and calculate**, or leave π in if the question says "in terms of π".

For example, radius 35 cm: circumference $= 70\pi$ cm and area $= 1225\pi$ cm².

Variations you will meet:

- **Radius or diameter from the circumference**: $r = C \div 2\pi$, $d = C \div \pi$. Circumference 88 cm gives $r = 14.0$ cm.
- **Radius from the area**: $r = \sqrt{A \div \pi}$. If the area is given in terms of π, such as 49π, then $r^2 = 49$ and $r = 7$.
- **Circumference from the area** (or the other way): find r first, then use the other formula.
- **Equal lengths or areas**: "the perimeter of the square equals the circumference of the circle". Work out the circle's value and set it equal: for radius 9, $4x = 2\pi \times 9$ gives $x = 4.5\pi$.

- **Several circles**: "9 small circles of radius 5 have the same total area as one large circle": $\pi R^2 = 9\pi \times 5^2$, so $R^2 = 225$ and $R = 15$.
- **Wheels**: turns $=$ distance $\div$ circumference. Convert km or m to cm first, and for "complete turns" round **down**.
- **Unit changes**: an answer "in millimetres" when the data is in cm means multiply by 10 at the end.
- **A circle round a square**: the square's diagonal is the diameter (use Pythagoras). **A circle inside a square**: the side is the diameter.

2. Arc length and the perimeter of a sector (19 questions)

1. **Find the sector angle** you need. For a major arc, use $360^\circ -$ the minor angle.
2. **Arc** $= \dfrac{\theta}{360} \times 2\pi r$.
3. **Perimeter** $=$ arc $+r + r$ if the question asks for the perimeter.

For example, a minor sector of radius 6.5 cm has angle 140°. The major sector angle is 220°, the major arc is $\frac{220}{360} \times 13\pi = 24.96$ cm and the perimeter of the major sector is $24.96 + 13 = 38.0$ cm.

Variations you will meet:

- **Semicircles and quarter circles**: arc $= \frac{1}{2} \times 2\pi r = \pi r$ or $\frac{1}{4} \times 2\pi r$. Don't forget the straight edges.
- **Answer in terms of** π: simplify the fraction: $\frac{300}{360} \times 18\pi = 15\pi$.
- **Find the angle from the perimeter**: subtract the two radii to get the arc, then solve. Perimeter 32 cm with $r = 10$: arc $= 12$, so $\frac{\theta}{360} \times 20\pi = 12$ and $\theta = 68.8^\circ$.
- **Find a value** n **when the arc is** $n\pi$: work out $\frac{\theta}{360} \times 2r$ as a number.
- **"Show that"** an arc is, say, 10π: write $\frac{200}{360} \times 2 \times \pi \times 9 = 10\pi$ with every number shown.
- **Extended: angle from a chord** (the chord and radius are given): $\sin\frac{\theta}{2} = \frac{\text{half chord}}{r}$, then use the arc formula.
- **Extended: algebra**: "the major sector's perimeter is three times the minor sector's". Write both perimeters with x and r and form an equation.

3. Compound shapes and shaded regions with circles (17 questions)

1. **Identify the pieces**: rectangles, triangles, semicircles, quarter circles, whole circles.
2. **Find every missing length.** A semicircle on the side of a rectangle has diameter equal to that side.
3. **Area**: add the pieces, or subtract the holes from the whole.
4. **Perimeter**: add only the **outside** edges: arcs and straight sides. Leave out edges that are inside the shape.
5. **Percentage** if asked: part $\div$ whole $\times 100$.

Variations you will meet:

- **A circle cut out of a rectangle, square or parallelogram**: shaded $=$ outer shape $-$ circle. Touching circles in a row: the rectangle's length is the number of circles $\times$ the diameter.

- **A quarter circle in a corner** (a patio in a garden, a sector in a square): whole area $-\frac{1}{4}\pi r^2$. When the angle comes from a diagonal of a square it is 45°; from a rectangle, find it with trigonometry.
- **Rings and double semicircles**: the region between two semicircles with the same centre has perimeter $\pi R + \pi r + 2(R - r)$ and area $\frac{1}{2}\pi R^2 - \frac{1}{2}\pi r^2$. Two sectors with the same centre and angle work the same way: big sector $-$ small sector.
- **A triangle with a sector removed**: equilateral triangles have 60° angles, so a sector at a corner has $\theta = 60^\circ$.
- **Money or materials**: area $\times$ cost per m² (convert units first).
- **"Give the units of your answer"**: an area needs cm² or m².

4. Area of a sector (12 questions)

1. **Find the angle** (use $360^\circ - \theta$ for a major sector).
2. **Sector area** $= \dfrac{\theta}{360} \times \pi r^2$.
3. Simplify in terms of π if asked.

For example, radius 6 cm and angle 40°: $\frac{1}{9} \times 36\pi = 4\pi$ cm².

Variations you will meet:

- **Semicircle area** $= \frac{1}{2}\pi r^2$; quarter circle $= \frac{1}{4}\pi r^2$.
- **Radius from the sector area**: $\frac{\theta}{360} \times \pi r^2 = A$, so $r^2 = A \div \left(\frac{\theta}{360}\pi\right)$, then square root.
- **Area from the perimeter**: the perimeter gives the arc, the arc gives the angle, the angle gives the area. For example, radius 12 cm and perimeter $(24 + 4\pi)$ cm: arc $= 4\pi$, so $\frac{\theta}{360} \times 24\pi = 4\pi$, $\theta = 60^\circ$ and the area $= \frac{1}{6} \times 144\pi = 24\pi$ cm².
- **"Show that the area is ... correct to 1 decimal place"**: write the calculation, show a value with at least one more figure, then round.
- **A prism with a sector or semicircle cross-section** (a cake with a slice cut out, a half-cylinder): volume $=$ sector area $\times$ length (see Surface area and volume).

5. Extended: segments (5 questions)

1. **Find the angle at the centre** if it is not given: from half the chord ($\sin\frac{\theta}{2} = \frac{\text{half chord}}{r}$) or from the distance d of the chord from O ($\cos\frac{\theta}{2} = \frac{d}{r}$).
2. **Minor segment area** $= \frac{\theta}{360}\pi r^2 - \frac{1}{2}r^2 \sin\theta$. **Major segment** $=$ major sector $+\frac{1}{2}r^2 \sin\theta$.
3. **Segment perimeter** $=$ arc $+$ chord. Find the chord with $2r\sin\frac{\theta}{2}$ (or the cosine rule).

Variations you will meet:

- **A tunnel or water trough**: the cross-section is a segment; multiply its area by the length for the volume. If the water depth is given, the chord is at distance $r - \text{depth}$ from O (or $\text{height} - r$ for a major segment).
- **Find the radius from a segment's area**: substitute the angle, write the area as a number times r^2, and solve. Show more figures than the rounded value you are asked to "show".

- **A polygon in a circle**: the angle at the centre for one side of a regular n-sided polygon is $\frac{360^\circ}{n}$.

6. Extended: sectors that make cones (3 questions)

When a sector is rolled up so its two radii meet, it makes a cone:

1. The **sector's radius** becomes the cone's **slant height** l.
2. The **arc length** becomes the **circumference of the cone's base**: $2\pi r_{\text{cone}} = \text{arc}$, which gives the base radius.
3. Use Pythagoras for the height, $h = \sqrt{l^2 - r_{\text{cone}}^2}$, then the cone formulas from the formula list (see Surface area and volume).

For example, a sector of radius 15 cm and angle 216° has arc $\frac{216}{360} \times 30\pi = 18\pi$, so the cone's base radius is 9 cm and its height is $\sqrt{225 - 81} = 12$ cm. Going the other way (cone to sector), find the slant height, then $\theta = \dfrac{2\pi r_{\text{cone}}}{2\pi l} \times 360$.

Worked examples

The bold codes show where marks are earned, as in Cambridge mark schemes. The number is how many marks.

- **M1** method mark: for a correct method, even if the numbers slip.
- **A1** accuracy mark: for a correct answer; it needs the M mark before it.
- **B1** mark for a correct result on its own, with no method needed.

Example 1

Core, non-calculator style.

A sector of a circle has radius 10 cm and sector angle 72°.

(a) Find the arc length of the sector. Give your answer in terms of π. **[2]**

(b) Find the perimeter of the sector. Give your answer in terms of π. **[1]**

(c) Find the area of the sector. Give your answer in terms of π. **[2]**

(a) The fraction is $\frac{72}{360} = \frac{1}{5}$.

$$\frac{72}{360} \times 2 \times \pi \times 10 \quad \mathbf{M1}$$

$= \frac{1}{5} \times 20\pi = 4\pi$ cm. **A1**

(b) Perimeter $= 4\pi + 10 + 10 = 4\pi + 20$ cm. **B1** (follow-through from their arc)

(c)

$$\frac{72}{360} \times \pi \times 10^2 \quad \textbf{M1}$$

$= \frac{1}{5} \times 100\pi = 20\pi$ cm². **A1**

Example 2

(a) A bicycle wheel has diameter 62 cm. Work out how many complete turns the wheel makes when the bicycle travels 2.5 km. **[3]**

(b) A circle has area 200 cm². Calculate its radius. **[2]**

(a) Circumference $= \pi \times 62 = 194.77\ldots$ cm. **M1**

2.5 km $= 2.5 \times 1000 \times 100 = 250\,000$ cm. **M1** for dividing the distance by the circumference, in the same units:

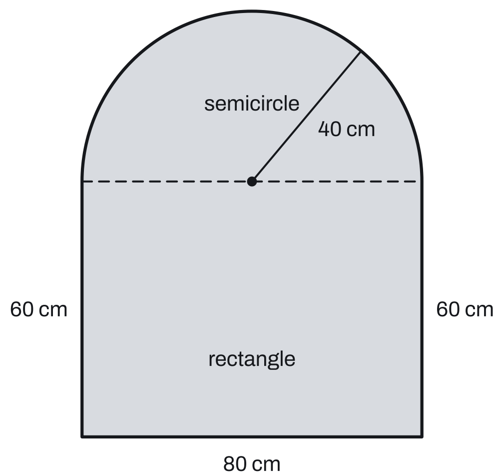
$$250\,000 \div 194.77\ldots = 1283.5\ldots$$

so the wheel makes 1283 complete turns. **A1** (round down: the 1284th turn is not complete)

(b) $\pi r^2 = 200$, so $r^2 = \dfrac{200}{\pi} = 63.66\ldots$ **M1**

$r = \sqrt{63.66\ldots} = 7.98$ cm. **A1**

Example 3



The diagram shows a window made from a rectangle and a semicircle.

(a) Calculate the perimeter of the window. **[3]**

(b) Calculate the area of the window. **[3]**

(a) The semicircle has diameter 80 cm, so $r = 40$ cm. Its arc is half the circumference:

$$\frac{1}{2} \times 2 \times \pi \times 40 = 40\pi = 125.66\ldots \quad \mathbf{M1}$$

The straight edges are $60 + 80 + 60 = 200$ cm (the dashed line is inside the window). **M1** for adding the three straight sides and the arc.

Perimeter $= 200 + 125.66\ldots = 326$ cm (3 s.f.). **A1**

(b) Rectangle: $80 \times 60 = 4800$ cm². **B1**

Semicircle: $\frac{1}{2} \times \pi \times 40^2 = 2513.2\ldots$ cm². **M1**

Area $= 4800 + 2513.2\ldots = 7313.2\ldots = 7310$ cm² (3 s.f.). **A1**

Example 4

Extended.

A and B are points on a circle with centre O and radius 8 cm. The chord AB is 10 cm long.

(a) Show that angle $AOB = 77.4^\circ$, correct to 1 decimal place. **[2]**

(b) Calculate the area of the minor segment cut off by AB. **[4]**

(c) Calculate the perimeter of the minor segment. **[2]**

(a) The line from O to the midpoint of AB is perpendicular to AB and cuts the angle in half. In the right-angled triangle, half the chord is 5 cm:

$$\sin\left(\tfrac{1}{2}\angle AOB\right) = \frac{5}{8} \quad \mathbf{M1}$$

$\frac{1}{2}\angle AOB = 38.68\ldots^\circ$, so $\angle AOB = 77.36\ldots^\circ = 77.4^\circ$. **A1** (the more accurate value must be seen before rounding)

(b) Sector: $\dfrac{77.36\ldots}{360} \times \pi \times 8^2 = 43.21\ldots$ cm². **M1**

Triangle: $\frac{1}{2} \times 8 \times 8 \times \sin 77.36\ldots^\circ = 31.22\ldots$ cm². **M1**

Segment $= 43.21\ldots - 31.22\ldots$ **M1** $= 11.98\ldots = 12.0$ cm² (3 s.f.). **A1**

The second diagram in "Understand it" shows these three areas.

(c) Arc $= \dfrac{77.36\ldots}{360} \times 2 \times \pi \times 8 = 10.80\ldots$ cm. **M1**

Perimeter $= 10.80\ldots + 10 = 20.8$ cm. **A1**

Common mistakes

- **Mixing up the two formulas.** Examiners report every year that candidates use πr^2 for a circumference or $2\pi r$ for an area, or invent a mixture such as $2\pi r^2$. Circumference is a length (cm); area is square units (cm²).
- **Using the diameter as the radius.** If the question gives the diameter, halve it before using πr^2 or $2\pi r$; if it gives the radius, don't halve it.
- **Working out a decimal when the question says "in terms of π".** Leave π as a letter and simplify the number: 70π, not 219.9, and not an unsimplified $\frac{120}{360} \times 36\pi$.
- **Wrong fraction of the circle.** The fraction is $\frac{\theta}{360}$, not a quarter or a third picked by eye. For a major sector use $360 - \theta$; examiners saw many answers that used the minor angle when the major arc was asked for.
- **Arc instead of area, or area instead of arc.** Read whether the question asks for a length or an area. A sector's arc uses $2\pi r$; its area uses πr^2.
- **Forgetting the radii in a sector's perimeter**, or adding them to an arc when only the arc was asked for. Around a compound shape, examiners saw joining lines added in and outside edges left out.
- **Using 3.14 or $\frac{22}{7}$ for π.** Reports note answers that lose the accuracy mark this way. Use the calculator's π key.
- **Rounding too early.** In long questions (segments, tunnels, percentages) keep full calculator values until the end; rounding the angle or the sector area part way through often pushes the final answer out of range.
- **Segments**: forgetting to take away (or, for a major segment, add) the triangle; assuming a part of the circle is a "nice" fraction such as $\frac{3}{5}$ instead of working out the angle.
- **Cones from sectors**: using the sector's radius as the cone's base radius, or halving the arc. The arc becomes the whole base circumference and the sector's radius becomes the slant height.

How to get the marks

- **Write the calculation with the numbers in**, such as $\frac{126}{360} \times 2 \times \pi \times 7.5$. That line earns the method mark even if the arithmetic slips; an answer alone can score nothing if it is wrong.
- **"In terms of π"** needs π in the final answer, in its simplest form. Mark schemes give "cao" (correct answer only), so $\frac{12}{3}\pi$ instead of 4π, or a decimal, loses the final mark.
- **Accuracy**: give non-exact answers to 3 significant figures (or the accuracy asked). Use the calculator's π or 3.142.
- **"Show that" a rounded value**, such as a length of 4.35 cm to 2 d.p.: write the full calculation and a value with more figures (such as 4.347) before you round.
- **Method marks follow through.** A wrong area used correctly in "grass area" or "percentage shaded" still earns the later method marks, so finish the question.
- **Complete turns, whole items**: round the way the context needs (down for complete turns, up for "how many tins are needed").
- **"Give the units of your answer"** carries a mark: cm² for an area, cm for a length.

Quick check

1. A circle has radius 6 cm. Find its circumference and its area, in terms of π.
2. The circumference of a circular pond is 50 m. Calculate its radius.
3. A sector has radius 15 cm and sector angle 48°. Find its arc length and its area, in terms of π.
4. **Extended.** A sector has radius 9 cm and perimeter 30 cm. Calculate its sector angle.
5. A square has side 10 cm. A quarter circle of radius 10 cm, centred at one corner, is drawn inside it. Calculate the area of the square outside the quarter circle.

Answers

1. Circumference $= 2 \times \pi \times 6 = 12\pi$ cm. Area $= \pi \times 6^2 = 36\pi$ cm².
2. $r = \dfrac{50}{2\pi} = 7.96$ m (3 s.f.).
3. $\frac{48}{360} = \frac{2}{15}$. Arc $= \frac{2}{15} \times 30\pi = 4\pi$ cm. Area $= \frac{2}{15} \times 225\pi = 30\pi$ cm².
4. Arc $= 30 - 9 - 9 = 12$ cm. $\frac{\theta}{360} \times 18\pi = 12$, so $\theta = \dfrac{12 \times 360}{18\pi} = 76.4^\circ$ (1 d.p.).
5. $100 - \frac{1}{4} \times \pi \times 10^2 = 100 - 25\pi = 21.5$ cm² (3 s.f.).

Past questions to try

- **0580/12/M/J/25 Q25**: the perimeter of a shape made from two semicircles, in terms of π.
- **0580/41/M/J/25 Q19**: the perimeter of a major sector.
- **0580/43/M/J/25 Q21**: a triangle with a sector removed.
- **0580/41/O/N/24 Q10**: a segment's area gives the radius, then the segment's perimeter.