Area and perimeter

G16, G17 · Geometry and measures · revision notes

Area and perimeter of rectangles, triangles, parallelograms, trapezia, circles and shapes made from them. These questions are common on both tiers, often in a context such as fencing, flooring or costs, and on Higher sometimes with algebra.

Key facts

- Rectangle = length × width
- Parallelogram = base × perpendicular height
- Circle: area = πr²; circumference = πd = 2πr
- 1 m² = 10 000 cm²; 1 cm² = 100 mm²
- Triangle = ½ × base × perpendicular height
- Trapezium = ½(a + b)h
- Semicircle: area = ½πr²; perimeter = ½πd + d

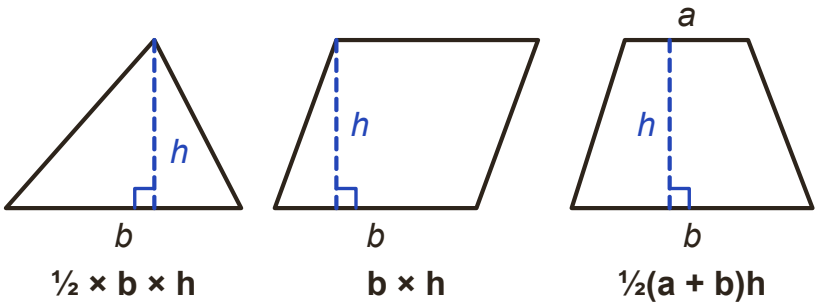
Notes

Perimeter

- Perimeter is the total distance around the outside of a shape, in units of length (cm, m).
- In compound shapes, find any missing sides first; opposite sides of a rectangle are equal.
- Circumference of a circle: $C = \pi d = 2\pi r$
- Perimeter of a semicircle = $\frac{1}{2}\pi d + d$: half the circumference plus the straight edge.

Area formulas

- Rectangle: area = length × width.
- Triangle: $A = \frac{1}{2}bh$, where h is the **perpendicular** height (at right angles to the base).
- Parallelogram: $A = bh$, using the perpendicular height, not the sloping side.
- Trapezium: $A = \frac{1}{2}(a + b)h$, where a and b are the parallel sides and h is the distance between them.



h is always the perpendicular height, never the sloping side.

- Circle: $A = \pi r^2$. Square the radius, not the diameter.

Compound shapes and problems

- Split the shape into simple shapes and add their areas, or take a larger shape and subtract the part cut out.
- Area units are squared: cm², m². 1 m² = 100 × 100 = 10 000 cm², and 1 cm² = 100 mm².
- In context, read what is needed: if one tin of paint covers 12 m², always round the number of tins **up**.
- Working backwards: if a circle has area 50 cm², then $r^2 = 50 \div \pi$, so $r = \sqrt{50 \div \pi} = 3.99$ cm.
- With algebra: write the area as an expression in x, set it equal to the given area and solve. Reject any value that gives a negative length. Grade 6+ only

How to answer each type of question

M = method mark, A = answer mark, B = a mark on its own.

Work out the area of a compound shape 3 marks **Grade 4**

1. Split the shape into simple parts and label them.
2. Find each area separately, finding any missing lengths first.
3. Add (or subtract) the areas and give squared units.

Example. A shape is made from a rectangle 12 cm by 8 cm and a semicircle. The diameter of the semicircle is one of the 8 cm sides of the rectangle.



Work out the area of the shape. Give your answer correct to 1 decimal place.

Model answer.

Rectangle = 12 × 8 = 96 cm²	(M1)
Semicircle = ½ × π × 4² = 25.13… cm²	(M1)
Total = 121.1 cm²	(A1)

Area problem in context (cost, tins or packs)

4 marks | Grade 5

1. Work out the area.
2. Divide by the amount one pack covers and round up to a whole number of packs.
3. Multiply by the price and give the answer in pounds.

Example. A lawn is in the shape of a trapezium. Its parallel sides are 14 m and 9 m long, and the perpendicular distance between them is 6 m. Grass seed is sold in boxes. One box covers 20 m² and costs £8.50.
Work out the cost of the boxes needed to seed the whole lawn.

Model answer.

Area = ½ × (14 + 9) × 6 (M1) = 69 m² (A1)
69 ÷ 20 = 3.45, so 4 boxes are needed (M1)
Cost = 4 × £8.50 = £34 (A1)

Circles: work backwards from the area or circumference

3 marks | Grade 5

1. Write the formula with the value you are given, e.g. $\pi r^2 = 30$.
2. Rearrange to find r, keeping the unrounded value.
3. Use r to find what the question asks for.

Example. A circular pond has an area of 30 m².
Work out the circumference of the pond. Give your answer correct to 3 significant figures.

Model answer.

$\pi r^2 = 30$ (M1), so $r = \sqrt{(30 \div \pi)} = 3.090\ldots$ m (M1)
Circumference = $2 \times \pi \times 3.090\ldots = 19.4$ m (A1)

Area with algebra

4 marks | Grade 6

1. Write the area as an expression in x and set it equal to the given area.
2. Rearrange to = 0 and solve (factorise if you can).
3. Reject any value that gives a negative length, then answer the question.

Example. A rectangle has length (x + 5) cm and width (x − 2) cm. Its area is 60 cm².
Work out the perimeter of the rectangle.

Model answer.

$(x + 5)(x - 2) = 60$ (M1)
$x^2 + 3x - 10 = 60$, so $x^2 + 3x - 70 = 0$ (M1)
$(x + 10)(x - 7) = 0$, so $x = 7$ ($x = -10$ gives negative lengths) (A1)
Length 12 cm, width 5 cm, so perimeter = 2 × (12 + 5) = 34 cm (A1)

Don’t lose marks

- Using the sloping side instead of the perpendicular height for a triangle or parallelogram.
- Forgetting the ½ in the triangle and trapezium formulas.
- Putting the diameter into πr^2.
- Leaving out the straight edge (the diameter) in the perimeter of a semicircle.
- Dividing by 100 instead of 10 000 to change cm^2 to m^2.
- Rounding the number of tins or boxes down.

More tips

Memory tricks

- Trapezium: 'add the parallel sides, halve, times the height'.
- Sense check an area by drawing a rectangle around the shape: the shape's area must be smaller.
- Use the π button and round only at the end.
- Changing area units: square the length conversion. 1 m = 100 cm, so 1 m^2 = 100^2 = 10 000 cm^2.

Exam technique

- Label each part of a compound shape and show its area; each part can earn a method mark.
- Always give units, and square them for area.
- Write money correctly, e.g. £34 or £34.00, never £34.0.
- In 'show that' or decision questions, show every calculation and finish with a sentence that answers the question.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 1 — **Find the perimeter by adding the sides**
Add the lengths of all the edges around the outside of the shape.

Grade 2 — **Find the area of rectangles and triangles**
Rectangle = length × width; triangle = ½ × base × perpendicular height.

Grade 3 — **Find the area of parallelograms and trapezia**
Parallelogram = base × perpendicular height; trapezium = ½(a + b)h.

Grade 4 — **Find the area and circumference of circles**
Area = πr^2; circumference = $\pi d = 2\pi r$.

Grade 4 — **Find areas and perimeters of compound shapes**
Split into rectangles, triangles and parts of circles, finding any missing lengths first.

Grade 5 — **Solve area problems in context and backwards**
e.g. work out the cost of turf for a lawn, or the radius of a circle from its area.

Grade 6 — **Form and solve equations from areas**
Write the area in terms of x, set it equal to the given value and solve, possibly as a quadratic.

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