

Cambridge IGCSE · Mathematics 0580 · Notes

Units, area and perimeter

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Read first: [Geometrical terms and symmetry](#)

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What you need to know

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

1. **Use metric units in real situations:** length (mm, cm, m, km), area (mm^2 , cm^2 , m^2 , km^2), volume (mm^3 , cm^3 , m^3), capacity (ml, l) and mass (g, kg).
2. **Convert a quantity into a larger or smaller unit**, including between units of area (such as cm^2 and m^2) and between units of volume and capacity (such as m^3 and litres).
3. **Work out the perimeter and area of a rectangle, a triangle, a parallelogram and a trapezium**, and work backwards from an area or perimeter to a missing length. Only the triangle's area formula is given in the exam; learn the others.
4. **Work out the perimeter and area of compound shapes** (shapes made of several simple shapes) **and parts of shapes**.

Core and Extended have the same content here. Extended papers ask harder versions, for example forming and solving an equation from an area. Circles, arcs and sectors, and surface area and volume, are separate topics.

Understand it

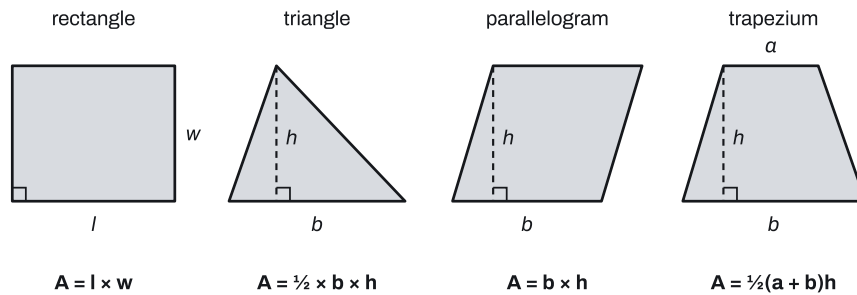
Perimeter and area

The **perimeter** is the distance all the way round the edge of a shape: add the lengths of every side. It is a length, so its units are mm, cm, m or km.

The **area** is the amount of flat space inside the shape: how many unit squares would cover it. A square 1 cm by 1 cm has area 1 cm^2 , so area is measured in square units: mm^2 , cm^2 , m^2 , km^2 .

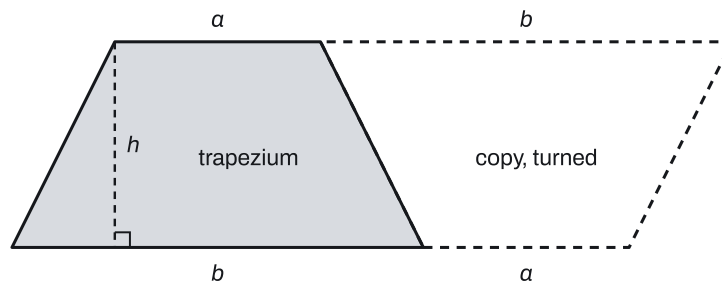
A rectangle 5 cm by 3 cm holds 3 rows of 5 one-centimetre squares, so its area is $5 \times 3 = 15 \text{ cm}^2$. Its perimeter is $5 + 3 + 5 + 3 = 16 \text{ cm}$. Two shapes can have the same area and different perimeters: a 3 cm by 16 cm rectangle has area 48 cm^2 , like a 6 cm by 8 cm one, but its perimeter is 38 cm, not 28 cm.

The four area formulas



The **height** in every formula is the **perpendicular height**: measured at right angles (90°) to the base, not along a sloping side.

- **Rectangle**: length $\times$ width. A square of side l has area l^2 .
- **Triangle**: a triangle is half of a rectangle (or parallelogram) with the same base and height, so its area is $\frac{1}{2} \times \text{base} \times \text{height}$. This is the one formula given in the exam.
- **Parallelogram**: cut the triangle off one end and slide it to the other end. You get a rectangle with the same base and the same height, so the area is **base $\times$ perpendicular height**. The sloping side is only used for the perimeter.
- **Trapezium**: it has one pair of parallel sides, a and b , a distance h apart. Put two copies together, one turned upside down, and they make a parallelogram:



The parallelogram has base $a + b$ and height h , so one trapezium has area

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

In words: **add the parallel sides, halve, and multiply by the distance between them.** For parallel sides 6 cm and 10 cm, 4 cm apart: $\frac{1}{2}(6 + 10) \times 4 = 32 \text{ cm}^2$.

Working backwards

If you know the area, put it into the formula and solve for the missing length. A triangle with area 30 cm^2 and base 12 cm: $\frac{1}{2} \times 12 \times h = 30$, so $6h = 30$ and $h = 5 \text{ cm}$. A square with area 49 cm^2 has side $\sqrt{49} = 7 \text{ cm}$.

Compound shapes

A **compound shape** is made of simple shapes. For the area, either:

- **split** it into rectangles, triangles and trapeziums and **add** their areas; or
- draw the rectangle round the whole shape and **subtract** the missing pieces.

Both give the same answer, so use whichever needs fewer calculations. A shaded region that is "part of a shape" works the same way: whole area minus the unshaded part.

Missing side lengths come from the ones you know. In a shape where every corner is a right angle, the horizontal pieces on one side add up to the total width, and the vertical pieces add up to the total height. For such an L-shape the perimeter is the same as the perimeter of the rectangle drawn round it, because the step just moves edges inwards without changing their total length.

When two shapes are **joined along an edge**, that shared edge is inside the new shape, so it no longer counts. Two identical rectangles each with perimeter P , joined along a whole edge of length e , make a shape with perimeter $2P - 2e$.

Shapes on a grid

On a 1 cm grid, find an area by:

- **using a formula**, reading the base and perpendicular height off the grid (for a triangle or trapezium, count the squares along the base and straight up);
- **counting squares**: whole squares count 1, half squares count $\frac{1}{2}$;
- **the surrounding rectangle**: draw the rectangle that just encloses the shape and subtract the right-angled triangles in its corners.

A perimeter on a grid is the total length of the edges. Count only along grid lines; a diagonal edge is not 1 cm per square.

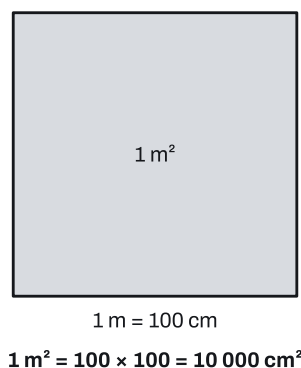
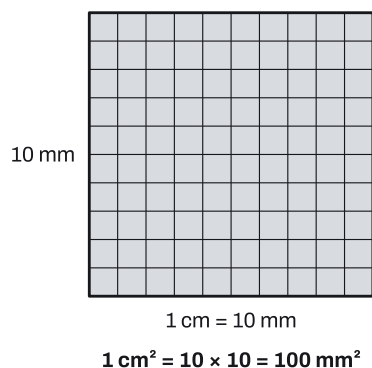
Metric units

Each prefix tells you the size: **kilo** means 1000, **centi** means one hundredth, **milli** means one thousandth.

Length	Mass	Capacity
1 cm = 10 mm	1 kg = 1000 g	1 l = 1000 ml
1 m = 100 cm = 1000 mm		
1 km = 1000 m		

To go to a **smaller** unit there are **more** of them, so **multiply**: $3.2 \text{ m} = 3.2 \times 100 = 320 \text{ cm}$. To go to a **larger** unit, **divide**: $4500 \text{ g} = 4500 \div 1000 = 4.5 \text{ kg}$. Check that the answer makes sense: a length in mm is a bigger number than the same length in m.

Units of area and volume



A square of side 1 cm is also a square of side 10 mm, so it holds $10 \times 10 = 100$ squares of 1 mm^2 . **Area conversions use the length factor squared**, and volume conversions use it cubed:

Length	Area	Volume
1 cm = 10 mm	$1 \text{ cm}^2 = 100 \text{ mm}^2$	$1 \text{ cm}^3 = 1000 \text{ mm}^3$
1 m = 100 cm	$1 \text{ m}^2 = 10\,000 \text{ cm}^2$	$1 \text{ m}^3 = 1\,000\,000 \text{ cm}^3$
1 km = 1000 m	$1 \text{ km}^2 = 1\,000\,000 \text{ m}^2$	

For example, $2.5 \text{ m}^2 = 2.5 \times 10\,000 = 25\,000 \text{ cm}^2$, and $650 \text{ cm}^2 = 650 \div 10\,000 = 0.065 \text{ m}^2$. Using 100 instead of 10 000 is the classic mistake.

Volume and capacity meet at one fact: 1 cm^3 holds 1 ml. So 1 litre = 1000 ml = 1000 cm^3 , and $1 \text{ m}^3 = 1\,000\,000 \text{ cm}^3 = 1000$ litres. A 6400 cm^3 jug holds $6400 \div 1000 = 6.4$ litres.

Land is sometimes measured in **hectares**; the question tells you that 1 hectare = $10\,000 \text{ m}^2$ when it uses them.

Convert first. If the lengths are in different units, change them to the same unit before you multiply, or convert the area at the end with the squared factor. Don't multiply a length in m by a length in cm.

Key facts and formulas

"Given" means it is on the List of formulas printed in the exam paper (Core and Extended). "Learn it" means you must remember it.

Formula	Status
Triangle: $A = \frac{1}{2}bh$ (h perpendicular to b)	Given
Rectangle: $A = l \times w$; square: $A = l^2$	Learn it
Parallelogram: $A = b \times h$ (h perpendicular)	Learn it
Trapezium: $A = \frac{1}{2}(a + b)h$ (a, b the parallel sides)	Learn it

Formula	Status
Perimeter = total length of all the sides; rectangle $P = 2(l + w)$	Learn it
1 cm = 10 mm, 1 m = 100 cm, 1 km = 1000 m	Learn it
1 cm ² = 100 mm ² , 1 m ² = 10 000 cm ² , 1 km ² = 1 000 000 m ²	Learn it
1 cm ³ = 1000 mm ³ , 1 m ³ = 1 000 000 cm ³	Learn it
1 ml = 1 cm ³ , 1 l = 1000 ml = 1000 cm ³ , 1 m ³ = 1000 l	Learn it
1 kg = 1000 g	Learn it

How to do it

In the questions we have tagged for this topic (65 questions, 2021–2025), the types came up this often. 15 of the 65 questions mix two or more types, so the counts add up to more than 65.

Question type	Questions
Area of a rectangle, triangle, parallelogram or trapezium	19
Converting units	19
Finding a missing length from an area or perimeter	13
Compound shapes	10
Shapes on a grid	10
Perimeter	9
Forming an equation from an area	3

1. Area of a rectangle, triangle, parallelogram or trapezium (19 questions)

1. **Name the shape** and write its formula.
2. **Pick the right lengths**: the perpendicular height (marked with a right angle, or dashed), and for a trapezium the two **parallel** sides.
3. **Substitute and calculate**. Give the units (cm², m²) if asked.

For example, a trapezium with parallel sides 11 cm and 17 cm and height 9 cm: $\frac{1}{2}(11 + 17) \times 9 = 126 \text{ cm}^2$.

Variations you will meet:

- **Sloping sides you don't need**. A trapezium or parallelogram diagram often also shows a slant side. Ignore it for the area.
- **The height is missing**. In a right-angled or isosceles triangle, or an isosceles trapezium, you may first need Pythagoras or trigonometry to find the height (see those topics), then use the formula.

- **Cost or amount per unit area.** Area $\times$ price per m^2 (or area $\div$ area covered by one tin). Make the units match first.
- **"Give the units of your answer":** an area needs square units, such as cm^2 .

2. Converting units (19 questions)

1. **Find the length factor** between the two units: 10 (mm, cm), 100 (cm, m), 1000 (m, km; g, kg; ml, l).
2. **Square it for area, cube it for volume.**
3. **Smaller unit: multiply. Larger unit: divide.**
4. **Sense check:** more of a small unit, fewer of a big one.

For example, $0.52 \text{ km} = 520 \text{ m}$; $36\,000 \text{ cm}^2 = 3.6 \text{ m}^2$; $0.004 \text{ m}^3 = 4000 \text{ cm}^3 = 4 \text{ litres}$.

Variations you will meet:

- **Volume to capacity:** cm^3 to litres, divide by 1000; m^3 to litres, multiply by 1000.
- **Compare two areas in different units**, such as $48\,000 \text{ cm}^2$ and 4.5 m^2 : convert one so both are in the same unit, then compare, and show the working.
- **Answers in a different unit:** a perimeter of 360 cm "in metres" is 3.6 m.
- **Hectares:** divide m^2 by 10 000 (the question gives the fact), then use any rate per hectare.
- **Other quantities in the same question**, such as hours in days or miles to kilometres, use the conversion the question gives or one you know (1 day = 24 hours).

3. Finding a missing length from an area or perimeter (13 questions)

1. **Write the area formula with the numbers in**, and put it equal to the given area.
2. **Simplify** each side, then **solve** for the unknown.
3. **Check** by putting your answer back in.

For example, a trapezium with parallel sides 5 cm and x cm, height 6 cm and area 48 cm^2 : $\frac{1}{2}(5 + x) \times 6 = 48$, so $3(5 + x) = 48$, $5 + x = 16$ and $x = 11$.

Variations you will meet:

- **A missing height:** for a trapezium, $h = \frac{2A}{a + b}$; for a triangle, $h = \frac{2A}{b}$; for a rectangle, width = $A \div$ length.
- **A square's side** from its area: take the square root.
- **Two identical shapes** make up the total area: halve the total first, or double the formula.
- **Equal areas:** "rectangle A has the same area as rectangle B ". Find B 's area, then A 's missing side, then compare perimeters.
- **A rectangle with a given area and perimeter:** list pairs of whole numbers with that product and check which add up to half the perimeter. Area 30 and perimeter 26: $l + w = 13$ and $l \times w = 30$, so 10 by 3.

4. Compound shapes (10 questions)

1. **Find every missing length** from the ones you know (total width minus the known pieces).
2. **Split into simple shapes** (or use a surrounding rectangle and subtract). Mark the pieces on the diagram.
3. **Work out each area and add** (or subtract).
4. For a **perimeter**, go round the outside once, adding every edge, and leave out any edge that is inside the shape.

Variations you will meet:

- **Shapes made from several copies** of one rectangle or triangle: area = number of copies $\times$ one area; for the perimeter, count only the outside edges.
- **Two rectangles joined**: perimeter = both perimeters $- 2 \times$ the shared length.
- **Shaded regions**: whole shape minus the hole, for example a parallelogram minus a circle or a square minus four triangles.
- **A quadrilateral made of two triangles** (often right-angled): add the two triangle areas.
- **Shapes with curved parts** use the circle formulas from Circles, arcs and sectors for those parts.

5. Shapes on a grid (10 questions)

1. **Recognise the shape**: rectangle, triangle, parallelogram or trapezium.
2. **Count** the base and perpendicular height in grid squares and use the formula, or count squares and half squares.
3. Give the units if asked (cm^2 on a 1 cm grid).

Variations you will meet:

- **An awkward triangle** (no side along the grid): draw the surrounding rectangle and subtract the corner triangles.
- **"Complete a triangle with the same area as the parallelogram"**: a triangle needs twice the height (or twice the base) of a parallelogram with the same base (or height).
- **Perimeter on a grid**: add the edge lengths along the grid lines.
- **Shade a fraction or percentage of the shape**: find the area first, then shade that many squares.

6. Perimeter (9 questions)

1. **Find every side**, including those not labelled (opposite sides of a rectangle or parallelogram are equal).
2. **Add them all**, going round once.
3. Give the units and convert if asked.

Variations you will meet:

- **A missing slant side** of a trapezium or triangle: find it first, often with Pythagoras.

- **"The same perimeter as"** another shape: work out the known perimeter, set it equal, and solve, for example $2 \times 6.4 + 2x = 30$ gives $x = 8.6$.
- **Squares in a pattern:** a rectangle 5 squares by 3 squares of side 20 cm has perimeter $2(100 + 60) = 320$ cm = 3.2 m.

7. Forming an equation from an area (3 questions)

Extended only.

1. Write the area in terms of x from the formula, for example $(x + 3)(2x - 1)$.
2. Set it equal to the given area, expand and rearrange to $= 0$.
3. Solve (factorise or use the quadratic formula) and **reject** any value that makes a length negative or zero.
4. Use the value to find what is asked, such as the perimeter.

"Show that" parts need every line of the expansion; the printed equation must appear as your last line.

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

A trapezium has parallel sides of length 9 cm and 15 cm. The perpendicular distance between them is 7 cm. The sloping sides are 7.6 cm and 8.1 cm.

(a) Work out the area of the trapezium. **[2]**

(b) Change your answer to part (a) into mm^2 . **[1]**

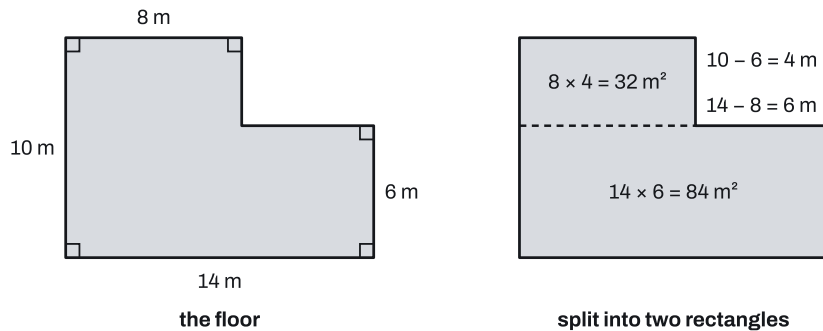
(a) Use the parallel sides and the perpendicular height (the sloping sides are not needed):

$$A = \frac{1}{2}(9 + 15) \times 7 \quad \mathbf{M1}$$

$$= 12 \times 7 = 84 \text{ cm}^2. \quad \mathbf{A1}$$

(b) $1 \text{ cm}^2 = 100 \text{ mm}^2$, so $84 \times 100 = 8400 \text{ mm}^2$. **B1**

Example 2



The left diagram shows the floor of a room. All the corners are right angles.

(a) Work out the perimeter of the floor. **[2]**

(b) Work out the area of the floor. **[3]**

(c) Carpet costs \$23.50 per square metre. Work out the cost of carpeting the whole floor. **[1]**

(a) The missing edges are $14 - 8 = 6 \text{ m}$ (across the step) and $10 - 6 = 4 \text{ m}$ (up the step). **M1** for finding a missing length.

Perimeter = $14 + 6 + 6 + 4 + 8 + 10 = 48 \text{ m}$. **A1** (Check: the rectangle round the shape is 14 by 10, perimeter $2(14 + 10) = 48$.)

(b) Split with a horizontal line, as on the right: $14 \times 6 = 84$ and $8 \times 4 = 32$. **M1** for one correct piece, **M1** for adding the two pieces.

Area = $84 + 32 = 116 \text{ m}^2$. **A1**

(Or subtract: $14 \times 10 - 6 \times 4 = 140 - 24 = 116$.)

(c) $116 \times 23.50 = 2726$, so \$2726. **B1** (follow-through from their area)

Example 3

A triangular field has a base of 320 m and a perpendicular height of 175 m. A farmer spreads fertiliser at a rate of 150 kg per hectare. [1 hectare = 10 000 m²]

(a) Work out the area of the field in hectares. **[3]**

(b) Work out the mass of fertiliser needed, in tonnes. [1 tonne = 1000 kg] **[2]**

(a) $A = \frac{1}{2} \times 320 \times 175$ **M1** = 28 000 m². **A1**

$28\,000 \div 10\,000 = 2.8$ hectares. **B1** (follow-through)

(b) $2.8 \times 150 = 420 \text{ kg}$ **M1**, and $420 \div 1000 = 0.42$ tonnes. **A1**

Example 4

Extended.

A rectangle has length $(x + 5)$ cm and width $(x - 2)$ cm. Its area is 60 cm^2 .

(a) Show that $x^2 + 3x - 70 = 0$. [2]

(b) Solve the equation and find the perimeter of the rectangle. [4]

(a) $(x + 5)(x - 2) = 60$ **M1**

$x^2 - 2x + 5x - 10 = 60$, so $x^2 + 3x - 70 = 0$. **A1**

(b) $(x + 10)(x - 7) = 0$ **M1**, so $x = -10$ or $x = 7$. **A1**

$x = -10$ would make both sides negative, so $x = 7$: the rectangle is 12 cm by 5 cm (check: $12 \times 5 = 60$). **M1**

Perimeter $= 2(12 + 5) = 34$ cm. **A1**

Common mistakes

- **Mixing up perimeter and area.** Perimeter adds lengths (cm); area multiplies them (cm^2). Examiners see answers that give one for the other every year. Read which is asked and check your units.
- **Using the sloping side as the height.** The height must be perpendicular to the base. In a parallelogram or trapezium, the slant side is only for the perimeter.
- **Adding the wrong sides of a trapezium.** Add the two **parallel** sides, not two sides that meet. Keep the bracket: $\frac{1}{2}(7 + 13) \times 5$, not $7 + 13 \times 5 \div 2$ worked in the wrong order.
- **Forgetting the $\frac{1}{2}$** for a triangle or trapezium, or using $\frac{1}{2}$ for a parallelogram, which doesn't need it.
- **Using the length factor for an area or volume.** 650 cm^2 is 0.065 m^2 (divide by 10 000), not 6.5 m^2 . 0.024 m^3 is $24\,000 \text{ cm}^3$ (multiply by 1 000 000), not 2.4 or 240.
- **Wrong basic factors.** 1 litre is 1000 ml, not 100; 1 km is 1000 m; 45 mm is 4.5 cm, not 0.45 cm.
- **Multiplying lengths in different units.** Change everything to one unit first.
- **Missing edges in a compound shape.** Work out every unlabelled length before adding, and don't count an edge that is inside the shape.
- **Only half the work for two identical pieces.** If a shape is two congruent trapeziums, the total area is twice one trapezium: halve the total, or double the formula.
- **Rounding too early.** Keep full calculator values and round only the final answer (normally to 3 significant figures).

How to get the marks

- **Write the formula with the numbers in**, such as $\frac{1}{2}(9 + 11) \times 6$. That line usually earns the method mark even if the arithmetic slips.

- **"Give the units of your answer"** carries a mark: use cm^2 , m^2 , and so on.
- **Conversions are usually 1 mark each, answer only**, so check the size of the answer makes sense.
- **Missing-length questions**: a correct equation such as $\frac{1}{2}(5 + 9)h = 56$ earns the method mark; then solve it.
- **Compound shapes**: show each piece's area. There are several correct ways to split, and any of them earns full marks.
- **"Show that"**: every step, and a final line that matches the printed answer. When the answer is given "correct to 2 decimal places", show a more accurate value first, such as 4.816 before giving 4.82.
- **"You must show all your working"** (for example when comparing two areas): an answer with no working scores nothing.
- **Accuracy**: exact answers stay exact; otherwise give 3 significant figures unless the question says otherwise. Money to the nearest cent.

Quick check

1. Complete: (a) $4.2 \text{ m}^2 = \text{___ cm}^2$; (b) $3500 \text{ mm}^2 = \text{___ cm}^2$; (c) $0.65 \text{ litres} = \text{___ cm}^3$.
2. A parallelogram has base 12.5 cm, perpendicular height 6.4 cm and sloping sides 8 cm. Find its area and its perimeter.
3. A triangle has area 54 cm^2 and base 12 cm. Find its perpendicular height.
4. A trapezium has parallel sides 8 cm and x cm, 6 cm apart. Its area is 69 cm^2 . Find x .
5. Two rectangles, each 3 cm by 10 cm, are joined along a whole 3 cm edge to make an L-shape. Find the area and the perimeter of the L-shape.

Answers

1. (a) $4.2 \times 10\,000 = 42\,000 \text{ cm}^2$. (b) $3500 \div 100 = 35 \text{ cm}^2$. (c) $0.65 \times 1000 = 650 \text{ cm}^3$.
2. Area = $12.5 \times 6.4 = 80 \text{ cm}^2$ (the sloping side is not used). Perimeter = $2(12.5 + 8) = 41 \text{ cm}$.
3. $\frac{1}{2} \times 12 \times h = 54$, so $6h = 54$ and $h = 9 \text{ cm}$.
4. $\frac{1}{2}(8 + x) \times 6 = 69$, so $3(8 + x) = 69$, $8 + x = 23$ and $x = 15$.
5. Area = $2 \times 30 = 60 \text{ cm}^2$. Each perimeter is $2(3 + 10) = 26 \text{ cm}$, and the shared 3 cm edge is lost from both: $2 \times 26 - 2 \times 3 = 46 \text{ cm}$.

Past questions to try

- **0580/12/O/N/25 Q17**: the area of a trapezium.
- **0580/31/O/N/25 Q13**: the height of a trapezium from its area, then cm^2 to m^2 .
- **0580/31/M/J/25 Q16**: a compound shape made from a square and four triangles.
- **0580/32/O/N/22 Q7**: two rectangles with equal areas, comparing their perimeters.