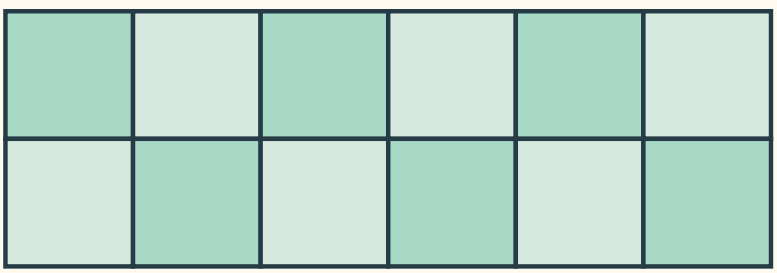
MATHS FIELD GUIDE · GRADE 9

Area, perimeter and units

OPENING PROBLEM

Twelve square tiles in two rows. What are the measurements?



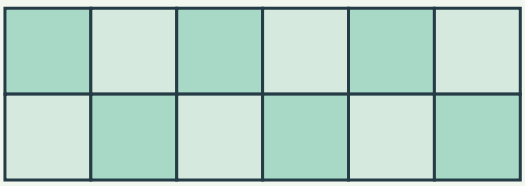
02 The same tiles can enclose different spaces
03 Rules and worked cases
04 A triangle is half a matching parallelogram
05 From the givens to the answer
06 Follow the unit through the calculation
07 Check your reasoning
08 Check your reasoning

ILLUSTRATED PROBLEM SHEET

The same tiles can enclose different spaces

Area counts the squares inside. Perimeter counts the unit edges on the boundary.

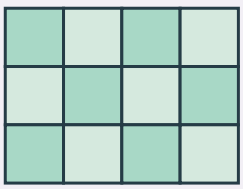
1



Twelve square tiles in two rows. What are the measurements?

Area 12 square units. Boundary 6 + 2 + 6 + 2 = 16 units.

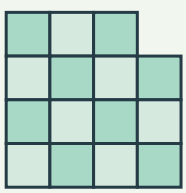
2



Rearrange the same twelve tiles into three rows. What changes?

Area stays 12. Perimeter falls to 14 because more tile edges meet inside.

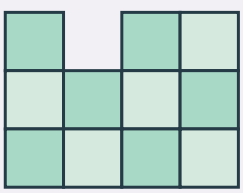
3



Remove the corner tile from a four-by-four square. What changes?

Area falls from 16 to 15. Two lost outer edges are replaced by two exposed ones, so perimeter stays 16.

4



Remove a top tile away from a corner. What changes?

Area falls from 12 to 11. One outer edge disappears and three appear, so perimeter rises from 14 to 16.

3 by 5 versus 5 by 3
same area and perimeter.

1 by 15 versus 3 by 5
same area, different perimeter.

CHAPTER PROBLEM

A triangle has base 18 cm and perpendicular height 7 cm. Find its area in cm².

63. Area = 18 × 7/2 = 63.

MATHS REFERENCE · GRADE 9

Area, perimeter and units

Rules, conditions and worked cases

Recognise the case	Mathematical reasoning
Rectangle 8 by 5 cm	Area 40 cm² counts squares. Perimeter 26 cm counts boundary lengths.
Scale length by three	Perimeter grows threefold; area grows ninefold because both dimensions scale.
Convert square units	1 m = 100 cm, so 1 m² = 10,000 cm². A 2,500 cm² panel covers 0.25 m².

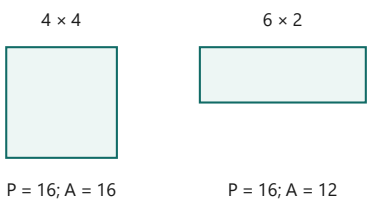
Read the representations

Perimeter measures the boundary; area measures the region

Perimeter adds the lengths around a closed boundary. Area counts how much flat space is covered, using unit squares.

The two pictured rectangles have the same perimeter but different areas. Neither measurement determines the other by itself.

A fence calculation uses length units; a floor covering calculation uses square units.



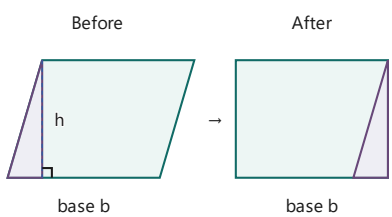
Lengths use units; areas use square units

A parallelogram can be cut into a rectangle

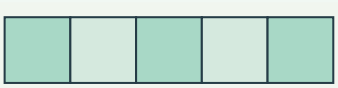
Cut off the left triangular corner along a perpendicular to the base. Translate that piece to fill the gap at the right.

No piece is stretched or lost. The rectangle has the same base b and perpendicular height h, so the parallelogram area is bh.

The sloping side is generally longer than h. It is used in perimeter, not as the perpendicular height.



The same pieces give area b × h



A 12 m fence is 1 m wide. How long is it?

Half the fence is 6 m. Removing the 1 m width leaves 5 m. Area is 5 m².

THEOREMS AND REPRESENTATIONS

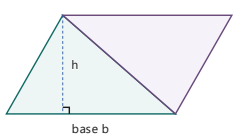
A triangle is half a matching parallelogram

A triangle is half a matching parallelogram

A half-turn of a triangle about a side midpoint places a congruent copy beside it. The pair makes a parallelogram.

The parallelogram has base b and the same perpendicular height h; its area is bh. Each congruent triangle has area bh/2.

The formula works for an obtuse triangle too. Its altitude may meet the extended base outside the triangle.



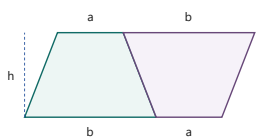
Each triangle has half the area bh

Two trapezia explain the average of the parallel sides

Rotate a congruent copy of the trapezium and fit the copies together. The outside parallelogram has base a + b and height h.

Its area is (a + b)h. Each trapezium therefore has area (a + b)h/2.

Only a and b are the parallel sides. The height is the perpendicular distance between their lines.



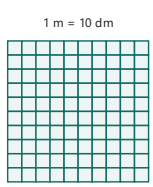
One trapezium: ½(a + b)h

Area conversion squares the length factor

One metre is ten decimetres. A square metre has ten rows of ten square decimetres.

Thus 1 m² = 100 dm². Similarly, 1 m² = 10,000 cm² because 1 m = 100 cm.

A conversion factor for length must be applied in both dimensions when converting area.



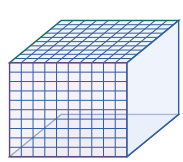
1 m² = 10 × 10 dm² = 100 dm²

Volume conversion cubes it; capacity uses the same space

A cubic metre contains ten layers of 100 cubic decimetres: 10 × 10 × 10 = 1000.

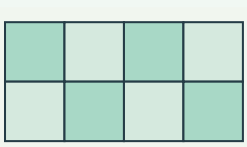
Therefore 1 m³ = 1000 dm³ = 1000 L. Also 1 L = 1000 cm³ = 1000 mL, so 1 cm³ = 1 mL.

Volume uses cubic units. Capacity measures how much a container holds; litres are compatible with cubic units.



10 × 10 × 10 small cubes

1 m³ = 1000 dm³ = 1000 L



Keep the 12 m fence and use 2 m for the width. What fits?

Length 4 m. The area rises to 8 m².

WORKED EXAMPLES

From the givens to the answer

Can the same conversion factor be used for every measurement?

A learner uses 1 m = 100 cm to claim 1 m² = 100 cm².

1. An area has two dimensions, each multiplied by 100. The area factor is 100 × 100.
2. For volume the factor is 100 × 100 × 100.
3. Keep the unit exponent visible before choosing the conversion factor.

Check another case

Example 1

Justify the trapezium area formula using two congruent copies.

Place a half-turned copy against the first to make a parallelogram.

Its base is the sum of the parallel sides and its height is the original perpendicular height.

Halve the parallelogram's area to obtain (a + b)h/2.

Example 2

Convert 0.36 m² to cm².

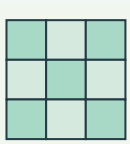
3600

0.36 × 10,000 = 3600.

Can three rectangles use the same fence?

A 24 m fence can enclose 1 × 11, 3 × 9 or 6 × 6 metre rectangles. Their areas are 11, 27 and 36 m².

For a given perimeter the sum of the two dimensions is fixed. Bringing these positive dimensions closer together increases their product.



Which whole-metre rectangle gives the most space with this fence?

3 by 3 encloses 9 m². The side pairs 1 and 5, 2 and 4, and 3 and 3 exhaust the possibilities.

ILLUSTRATED PROBLEM SHEET

Follow the unit through the calculation

Write the unit with the number. Match units before adding or subtracting.

1

Metres	Centimetres
1	100
3	300
1½	150

How long is 1½ m in centimetres?

One metre is 100 cm and half a metre is 50 cm. Together they give 150 cm.

2

Mass	In grams
1 kg	1000
1 kg 8 g	1008

Which zero matters?

Eight grams adds eight ones, not eight hundreds.

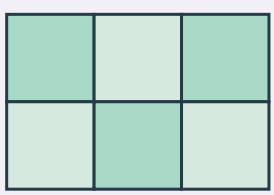
3

10:45 → 11:00
↓
15 min + 20 min
↓
11:20

How long from 10:45 to 11:20?

Thirty-five minutes. Split at the hour so the minutes can be added.

4



Each square has side 1 m. What is its area in cm²?

Each small square has 100 × 100 cm². Six of them have 60,000 cm².

1 m = 100 cm
length factor 100.

1 m² = 10,000 cm²
area factor 100 × 100.

CHAPTER PROBLEM

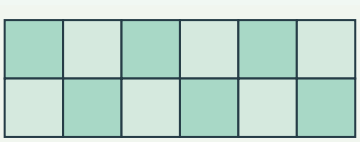
Convert 2.5 m² to cm².

25000. 2.5 × 10,000 = 25,000 cm².

QUESTION BANK · FOLD OR COVER THE RIGHT COLUMN

Check your reasoning

Try the problem	Solution and reasoning
01 A 3 by 3 square loses its centre tile. Count the edge around the hole too. What are the new measures?	Eight square units and sixteen boundary units: twelve outside and four around the hole.
02 Which holds more, 2 L 50 mL or 2200 mL?	2050 mL is 150 mL less than 2200 mL.
03 A parallelogram has base 16 cm and perpendicular height 9 cm. Find its area in cm².	144 Area = 16 × 9 = 144.
04 A trapezium has parallel sides 8 cm and 14 cm and height 5 cm. Find its area in cm².	55 Area = (8 + 14) × 5/2 = 55.
05 A rectangle has sides 13 cm and 6 cm. Find its perimeter in cm.	38 P = 2(13 + 6) = 38.
06 Convert 0.08 m³ to litres.	80 0.08 × 1000 = 80 L.



Instead keep the area at 12 m². Is 12 m of fence enough here?

No. A 6 by 2 rectangle needs 16 m. The number 12 now measures squares inside.

QUESTION BANK · FOLD OR COVER THE RIGHT COLUMN

Check your reasoning

Try the problem	Solution and reasoning
07 Convert 650 cm³ to litres.	13/20 650/1000 = 13/20 L.
08 Why is the sloping side not usually the height in a parallelogram area calculation?	Height is measured perpendicular to the chosen base. The cut-and-move rectangle preserves that perpendicular distance. A sloping side generally measures a longer path and would overstate bh.
09 Explain why two shapes with equal perimeters can have different areas.	Perimeter fixes the total boundary length. Changing side lengths can redistribute that boundary and change the enclosed region. For example, rectangles 5 by 5 and 8 by 2 both have perimeter 20 but areas 25 and 16.
10 A triangle has area 72 cm² and base 16 cm. Find its perpendicular height in cm.	9 72 = 16h/2 gives h = 9.
11 Convert 1.75 L to cm³.	1750 Multiply by 1000 to obtain 1750 cm³.

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