Double It, Halve It: Area of a Trapezium

Teacher		**Class**	Year 7
Subject	Maths	**Topic**	Area of a trapezium
Date		**Room**	
Lesson length	60 minutes	**Country**	United Kingdom

Pupils derive the trapezium area formula by joining two trapezia. They then apply it accurately using perpendicular height.

Curriculum links

- derive and apply formulae to calculate and solve problems involving: perimeter and area of triangles, parallelograms, trapezia, volume of cuboids (including cubes) and other prisms (including cylinders)

Learning objectives

- Students will derive the trapezium area formula by doubling to a parallelogram.
- Students will calculate trapezium area using the average of parallel sides.
- Students will solve area problems using perpendicular height, not slant side.

Success criteria

- I can explain why trapezium area is half of (a + b) x h.
- I can find trapezium area using parallel sides and perpendicular height.
- I can work backwards to find a missing parallel side from area.

What students already know

Show a triangle, parallelogram and trapezium. Ask: which sides are parallel and where is the perpendicular height for area?

Key words

trapezium	a four-sided shape with one pair of sides that never meet [2]
parallel	lines that stay the same distance apart and never meet [1]
perpendicular height	the shortest gap between the two matching sides, meeting them at 90 degrees [2]
average	the middle value found by adding two numbers and halving the total [3]

Materials

- squared paper, rulers, scissors, coloured pencils, glue sticks
- mini whiteboards, pens and cloths
- Slides 2-7 and 9-12, Video clip 1 (0:00–2:36)
- Worksheet Task B printed per pupil, counters for bingo style check

Before the lesson

- Print Worksheet Task B and pre-drawn trapezia on squared paper with arrows on parallel sides
- Test Slide 6 Video clip 1 (0:00–2:36) and enlarge trapezium diagrams for stations
- Set out squared paper, rulers, scissors, coloured pencils and glue sticks per pair

Lesson outline

0–5 min **Starter** 5 min · Whole class

Recall parallel sides and perpendicular height and hook pupils into deriving the formula.

YOU DO

1. Show Slides 2-3 with objectives and trapezium diagram.
2. Use hook: I have got one wonky quadrilateral. If I give you two of them, can you make a shape you already know how to measure?
3. Ask pupils to point out the pair of parallel sides and the height on whiteboards.
4. Link to prior learning: area of parallelogram is base times perpendicular height.

STUDENTS DO

1. Sketch a trapezium and mark the two parallel sides with arrows.
2. Show on whiteboards where they think the height should go.
3. Predict what shape two identical trapezia might make.

Say: Today we will double a trapezium to discover its area. A trapezium has exactly one pair of parallel sides [2]. Your job is to turn two copies into a shape we can already measure.

Ask: How do you know which sides are a and b? (They are the parallel sides, marked with arrows on the diagram [2].) · Where must the height h go? (Across the gap between a and b, meeting them at right angles [2].)

Check understanding: Whiteboards up on cue; if height is drawn slanted, re-show right-angle mark and correct as a class.

Support: Give pre-drawn trapezia on squared paper with parallel sides already marked with arrows. **Stretch:** Ask what happens to the average if a = b, and what shape that would be.

Use: Slides 2-3

5–20 min **Teaching** 15 min · Whole class

Derive A = ½(a + b)h by joining two congruent trapezia into a parallelogram.

YOU DO

1. Show Slide 4 and explain two identical trapezia make one parallelogram.
2. Play Video clip 1 (0:00–2:36) on Slide 6 showing rotate one copy 180 degrees and join.
3. Model with large cut-outs: colour parallel sides two colours, join, label base (a + b) and height h.
4. Write formula under joined shape and explain halving for one trapezium.

STUDENTS DO

1. Watch video and note where (a + b) comes from.
2. Colour parallel sides on own pair and help label base and height.
3. Chant the three steps: add, halve, times height.

Say: The base of the new parallelogram is the total of the two parallel sides (a + b) [1]. Its area is (a + b) x h. One trapezium is half of that, so area is the average length of the parallel sides multiplied by the perpendicular height [1].

Worked example: Trapezium with a = 8 cm, b = 12 cm, h = 5 cm. Join two copies: base = 8 + 12 = 20 cm. Parallelogram = 20 x 5 = 100 cm². One trapezium = 100 ÷ 2 = 50 cm², so ½ x (8 + 12) x 5 = 50 cm² [2].

Ask: Why is the parallelogram base a + b? (It joins one short parallel side and one long parallel side end to end [1].) · Why do we halve at the end? (The parallelogram uses two trapezia, so one trapezium is half the area [1].)

Check understanding: Ask hinge question on whiteboards: parallelogram area (a + b)h = ? for a=6, b=10, h=4; expect 64, then half is 32. Reteach if halving missed.

Support: Keep a labelled joined shape on the board with a, b and h colour-coded. **Stretch:** Explain why the same joining trick with a right-angled trapezium makes a rectangle.

Use: Slides 4-6, Video clip 1 (0:00–2:36)

20–30 min **Guided practice** 10 min · Whole class

Practise the three-step method and learn to ignore the slant side.

YOU DO

1. Show Slide 7 three steps: add parallel sides, halve to average them, multiply by h.
2. Model ½ x (8 + 12) x 5 = 50 cm² [2] stressing writing formula first.
3. Show a diagram with a 7 cm slant side and 5 cm height and ask which to use.
4. Introduce key words on Slide 10 and insist on square units.

STUDENTS DO

1. Copy the two worked examples with formula first.
2. Call out fake numbers when teacher points to slant side.
3. Practise reading a, b and h from arrow and right-angle marks.

Say: Add a and b, halve it to average them, then times h. The height must be the perpendicular distance between the parallel sides, not the length of a slanted side [2]. Area is always measured in square units [5].

Worked example: Parallel sides 6 cm and 10 cm, height 4 cm, slant side 5 cm ignored. A = ½ x (6 + 10) x 4 = ½ x 16 x 4 = 8 x 4 = 32 cm² [5].

Ask: Height is 5 cm but slant side is 7 cm. Which do you use, and why? (Use 5 cm because height meets the parallel sides at right angles [2].) · What do we write before any numbers? (A = ½(a + b) x h to earn method and avoid missing the half [5].)

Check understanding: Mini whiteboards: give a=9, b=15, h=6; expect 72 cm². If errors, revisit arrows and right-angle symbol.

Support: Use diagrams where parallel sides have matching arrow marks and height has a right-angle mark [2].
Stretch: Add a card where trapezium is turned sideways, so pupils must still find the perpendicular gap.

Use: Slides 7, 10

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30–50 min **Main activity** 20 min · Pairs

Build the joined parallelogram and then calculate four trapezia independently.

YOU DO

1. Hand out squared paper shapes, scissors and glue and show Slide 9 task.
2. Direct pairs to cut two congruent trapezia, colour parallel sides, rotate one 180 degrees and stick as parallelogram.
3. Circulate to check labels a, b and perpendicular h, then set Worksheet Task B.
4. Stop for mid-point check on 6 cm, 10 cm, 4 cm question before challenge.

STUDENTS DO

1. Cut, colour, join and stick two trapezia to form a parallelogram and label it.
2. Complete Worksheet Task B: work out each area, writing formula before calculating.
3. In pairs, calculate including 6 cm, 10 cm, 4 cm and attempt missing-side challenge.

Say: Make my trapezium using two copies. Stick your parallelogram, label a, b and h, and write A = ½(a + b)h underneath. Then work out four areas on your own, recording a, b and h with the right-angle mark.

Worked example: Challenge check: area 60 cm², h = 6 cm, a = 7 cm. Write 60 = ½ x (7 + b) x 6 [2]. So 60 = 3 x (7 + b), 20 = 7 + b, b = 13 cm [2]. Check by ½ x (7 + 13) x 6 = 60 cm².

Ask: How does your stuck shape prove the formula? (Two trapezia make a parallelogram base (a + b), area (a + b)h, so one is half [1].) · If area ÷ h = 10, what do you know about a and b? (Their average is 10, so a + b = 20, since the formula averages the parallel sides [2].)

Check understanding: Gallery of stuck parallelograms plus spot-check Task B answers; pull group for reteach if slant side used.

Support: Give pre-drawn trapezia with arrows and a frame: area ÷ h = average, then double and subtract.
Stretch: Make your own missing-side puzzle for your partner with whole-number answers and try sideways trapezium.

Use: Slide 9, Worksheet Task B

50–60 min **Plenary** 10 min · Whole class

Secure the formula, correct common errors and check who can apply it.

YOU DO

1. Run Slide 11 vote on favourite version: average then times height or add, halve, times h.
2. Show three error cards: slant height, wrong sides, forgotten half, and ask pairs to fix.
3. Run Slide 12 quick quiz as exit ticket on whiteboards.
4. Summarise against objectives and set homework.

STUDENTS DO

1. Vote and explain which formula wording clicks best.
2. Spot the mistake in three workings and rewrite correctly with formula first.
3. Answer three quiz questions on whiteboards and self-mark.

Say: The height must be at right angles to both parallel sides, not along a sloping edge [5]. Only the two parallel sides go in the formula. Always write the ½ and finish with square units like cm² [5].

Ask: Someone used the slant side for h. What is the fix? (Replace with perpendicular height shown by right-angle or dashed line [3].) · Someone got double the answer. What did they miss? (Forgetting to halve; the formula includes ½ and missing it doubles the answer [5].)

Check understanding: Exit ticket whiteboards: 32 cm², 50 cm², b = 13 cm. Collect counts; follow up with anyone below 2/3 next lesson.

Support: Let pupils keep a formula card showing A = ½(a + b) x h with a labelled sketch [3]. **Stretch:** Write a top tip for Year 6 explaining why the ½ is essential.

Use: Slides 11-12

Common mistakes

Mistake	How to spot it	How to fix it
Using slant side instead of perpendicular height	Answer too big and working uses side without right-angle mark	Circle height with right-angle symbol; height is the perpendicular gap between sides [2].
Forgetting to halve	Answer exactly double, e.g. 64 cm² instead of 32 cm²	Always write A = ½(a + b) x h first; missing the half doubles the answer [5].
Adding non-parallel sides into a + b	Uses all four sides or the legs in the brackets	Find arrows for parallel sides first; only the two parallel sides go in [2].

Support

- Give pre-drawn trapezia on squared paper with parallel sides marked with arrows
- Use right-angle marks and formula cards with labelled a, b, h sketch
- Provide area ÷ h = average frame for missing-side work

Stretch

- Try joining trick with right-angled trapezium and explain why it makes a rectangle
- Solve sideways trapezium and decimal sides 4.5 cm and 7.5 cm with height 8 cm
- Create missing-side puzzles and compound rectangle-plus-trapezium totals

For the LSE or teaching assistant

Support cutting and labelling in main activity; prompt arrow and right-angle checks and keep formula card visible.

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Safety

- Teach safe scissor use and keep fingers clear of blades when cutting.

Check for understanding

Question	Answer
Parallel sides 6 cm and 10 cm, height 4 cm. Area?	32 cm² [5]
Parallel sides 8 cm and 12 cm, height 5 cm. Area?	50 cm² [2]
Area 60 cm², height 6 cm, one side 7 cm — find b.	13 cm [2]

Homework

Complete Worksheet Task C trickier problems, beware the slant side.

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