### 5.4 Area of a Trapezoid

GOAL
Develop and apply the formula for the area of a trapezoid.

## Learn about the Math

A new water park has the shape of a trapezoid. The parallel sides are 60 m apart. In the winter, the water park will be covered with canvas. Yuki and Sandra want to calculate the area of the water park to find out how much canvas is needed.

## 2 What is the area of the water park?


A. Draw a diagram of the trapezoid on centimetre grid paper. Make two copies.
B. On one copy, divide your trapezoid into two or three simpler shapes (rectangles and/or triangles).
C. Use a formula you already know to calculate the area of each simpler shape.

D. Calculate the area of the water park using the areas in step C.
E. On the other copy, create a congruent trapezoid next to the original trapezoid, so that the two trapezoids form a parallelogram.
F. Use a formula to calculate the area of the parallelogram.
G. Calculate the area of the trapezoid using the area of the parallelogram.


## Reflecting

1. Can a trapezoid always be divided into a rectangle and two triangles? Draw examples on grid paper to support your answer.
2. Why can a trapezoid always be divided into two triangles that have the same height? What formula would this give for the area of a trapezoid?
3. Why can a trapezoid always be thought of as half a parallelogram? What formula would this give for the area of a trapezoid?


## Work with the Math

## Example 1: Calculating the area of a trapezoid by dividing it into triangles



I drew a trapezoid and divided it into 2 triangles. In $\triangle A B C$, the base is side $B C$, which is 5 m . The height is 3 m .

$$
\text { Area of } \begin{aligned}
\triangle A B C & =(b \times h) \div 2 \\
& =(5 \mathrm{~m} \times 3 \mathrm{~m}) \div 2 \\
& =7.5 \mathrm{~m}^{2}
\end{aligned}
$$

$$
\text { Area of } \begin{aligned}
\triangle A D C & =(b \times h) \div 2 & & \text { In } \triangle A D C, \text { the base is side } D A, \text { which is } 3 \mathrm{~m} . \text { The } \\
& =(3 \mathrm{~m} \times 3 \mathrm{~m}) \div 2 & & \text { height is still } 3 \mathrm{~m} .
\end{aligned}
$$

$7.5 \mathrm{~m}^{2}+4.5 \mathrm{~m}^{2}=12 \mathrm{~m}^{2}$

The area of the trapezoid is the sum of the areas of the triangles.
The area of the wading pool is $12 \mathrm{~m}^{2}$.

## Example 2: Calculating the area of a trapezoid by making a parallelogram

Calculate the area of the wading pool above.
Sandra's Solution


Area of parallelogram $=b \times h$

$$
\begin{aligned}
& =8 \mathrm{~m} \times 3 \mathrm{~m} \\
& =24 \mathrm{~m}^{2}
\end{aligned}
$$

I drew the trapezoid. Then I copied it to form a parallelogram.
The base of this parallelogram is $5 \mathrm{~m}+3 \mathrm{~m}=8 \mathrm{~m}$. Its height is 3 m .

The trapezoid is half the area of the parallelogram, so its area must be half of $24 \mathrm{~m}^{2}$.
The area of the wading pool is $12 \mathrm{~m}^{2}$.

## Example 3: Calculating the area of a trapezoid using a formula

Calculate the area of the wading pool.

Solution

$$
\begin{aligned}
A & =(a+b) \times h \div 2 \\
& =(3 \mathrm{~m}+5 \mathrm{~m}) \times 3 \mathrm{~m} \div 2 \\
& =8 \mathrm{~m} \times 3 \mathrm{~m} \div 2 \\
& =24 \mathrm{~m}^{2} \div 2 \\
& =12 \mathrm{~m}^{2}
\end{aligned}
$$



This is the formula for the area of a trapezoid, where a and $b$ represent the lengths of the parallel sides. You can choose these values: $a=3 \mathrm{~m}, \mathrm{~b}=5 \mathrm{~m}$, and $\mathrm{h}=3 \mathrm{~m}$. (You could have chosen $\mathrm{a}=5 \mathrm{~m}$ and $\mathrm{b}=3 \mathrm{~m}$ instead.)
Substitute these values into the formula. The area of the wading pool is $12 \mathrm{~m}^{2}$.

## (A) Checking

4. Draw the following trapezoid on grid paper.

Calculate the area of the trapezoid by dividing the shape into simpler shapes.

5. Trace trapezoid $A B C D$, and show how two trapezoids form a parallelogram. Calculate the area of trapezoid $A B C D$.

6. Calculate the area of this trapezoid using a formula.


## B Practising

7. a) Which side length of the trapezoid below is not required to calculate its area?
b) Calculate the area and the perimeter of the trapezoid to the nearest tenth.

8. On centimetre grid paper, draw a trapezoid with an area of $13 \mathrm{~cm}^{2}$.
9. Calculate the area of each trapezoid.
a)

b)

10. A garden has the dimensions shown below. Which calculation could you use to find the area of the garden? Explain your thinking.
a) Area $=(3 \mathrm{~m}+1 \mathrm{~m}) \times 4 \mathrm{~m} \div 2$
b) Area $=1 \mathrm{~m}+(4 \mathrm{~m} \times 3 \mathrm{~m}) \div 2$
c) Area $=(4 \mathrm{~m}+1 \mathrm{~m}) \times 3 \mathrm{~m} \div 2$
d) Area $=(1 \mathrm{~m}+3 \mathrm{~m}) \times 4 \mathrm{~m} \div 2$
e) Area $=(4 \mathrm{~m}+3 \mathrm{~m}) \times 1 \mathrm{~m} \div 2$

11. A trapezoid has an area of $10.5 \mathrm{~cm}^{2}$ and parallel sides that measure 5.0 cm and 2.0 cm . What is the height of the trapezoid? Explain what you did.
12. a) A trapezoid has parallel sides that are 28 cm and 40 cm long, and 18 cm apart. Calculate the area of the trapezoid.
b) Another trapezoid has parallel sides that are 2 m and 5 m long, and 3 cm apart. Calculate its area.
13. A trapezoid has an area of $20 \mathrm{~cm}^{2}$ and a height of 5 cm . What is the sum of its top and bottom sides?
14. A kindergarten classroom has 10 trapezoidshaped tables. Some Grade 7 students have volunteered to paint game boards to cover the top surfaces of the tables. Each table has the measurements shown. What is the total area the students will paint?
1.50 m


## C Extending

15. Use what you know about trapezoids to calculate the area of this regular hexagon. Explain what you did.

16. The length of the shortest side of a red pattern block is 25 mm . What is the area of the trapezoid?
