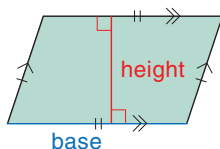


6.1

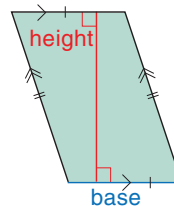
Area of a Parallelogram

Focus Use a formula to find the area of a parallelogram.

This is a **parallelogram**.
How would you describe it?



Here is the same parallelogram.
Any side of the parallelogram is a base.
The height is perpendicular to the base.



Explore

Work with a partner.

You will need a tangram and grid paper.

- One tan is a parallelogram. Find its area.
- Make another parallelogram by combining tans. Find the area of the parallelogram.
- Continue to combine tans to make different parallelograms. Find the area of each parallelogram you make.
- Record your work. Draw each parallelogram on grid paper.
- Use variables. Write a formula to find the area of a parallelogram.



Reflect & Share

How did you find the area of each parallelogram?

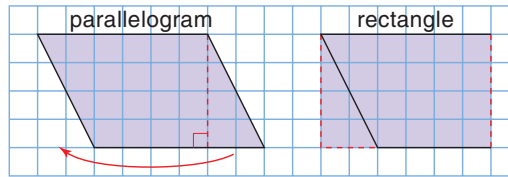
Which different strategies did you use?

Which strategy helped you write the formula for the area?

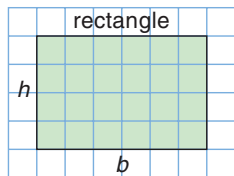
Connect

Recall that both a rectangle and a square are parallelograms.

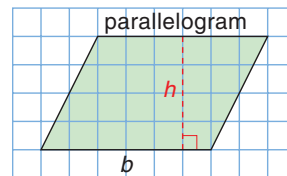
Any parallelogram that is not a rectangle can be “cut” and rearranged to form a rectangle.



The parallelogram and the rectangle have the same area.
 The area of a parallelogram is equal to the area of a rectangle with the same height and base.
 To find the area of a parallelogram, multiply the base by the height.



Area of rectangle:
 $A = bh$

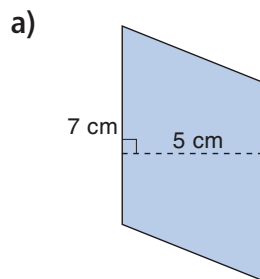


Area of parallelogram:
 $A = bh$

b represents
 the base.
 h represents
 the height.

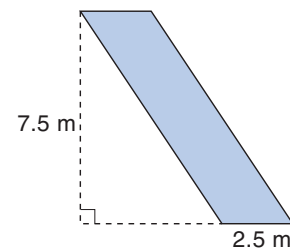
Example

Calculate the area of each parallelogram.



a) $A = bh$
 Substitute $b = 7$ and $h = 5$.
 $A = 7 \times 5$
 $= 35$
 The area of the parallelogram is 35 cm^2 .

b) The height can be drawn outside the parallelogram.



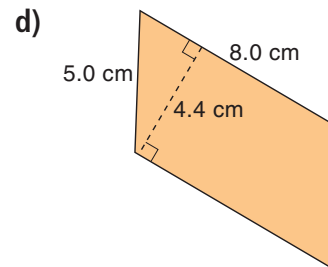
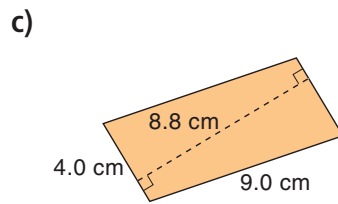
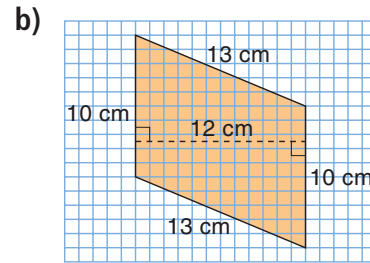
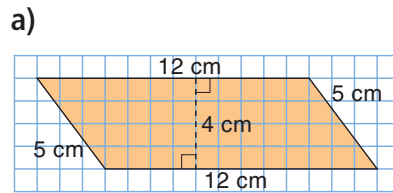
b) $A = bh$
 Substitute $b = 2.5$ and $h = 7.5$.
 $A = 2.5 \times 7.5$
 $= 18.75$
 The area of the parallelogram is 18.75 m^2 .

Practice

Recall that you can use a protractor to draw the height perpendicular to the base.

The base of a parallelogram is not always horizontal.

1. Identify one base and height of each parallelogram.

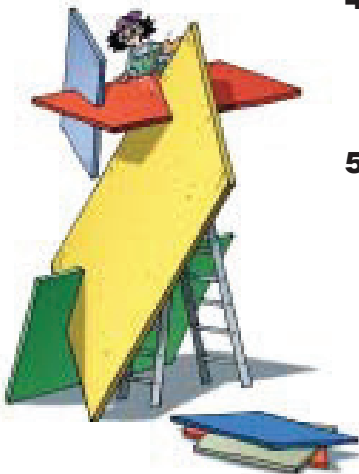


2. Find the area of each parallelogram in question 1.

3. a) On 1-cm grid paper, draw 3 different parallelograms with each base and height.
 i) base: 3 cm; height: 5 cm ii) base: 3.5 cm; height: 7.0 cm
 b) Find the area of each parallelogram you drew in part a. What do you notice?

4. On 1-cm grid paper, draw as many different parallelograms as you can with each area.
 a) 10 cm^2 b) 18 cm^2 c) 28 cm^2

5. **Assessment Focus** Use 1-cm grid paper. Draw a parallelogram, which is not a rectangle, with base 6 cm and height 4 cm.
 a) What is the area of the parallelogram?
 b) Change the base to draw a parallelogram with twice the area. What is the base?
 c) Change the height to draw a parallelogram with twice the area. What is the height?
 d) Change the base and height to draw a parallelogram with twice the area.
 How many different pairs of base and height can you find? Show your work.



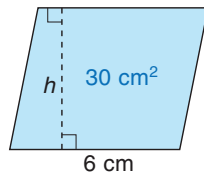
Mental Math

It is Wednesday, January 14.
Kim and Sun-Yi are working together.
Kim works every Wednesday.
Sun-Yi works every 5th day.
When will Kim and Sun-Yi next work together?

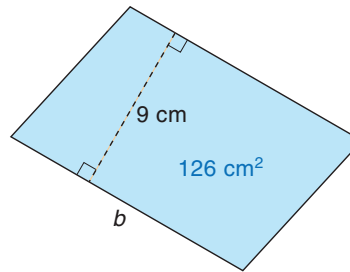


6. The area of each parallelogram is given. Find each unknown measure.

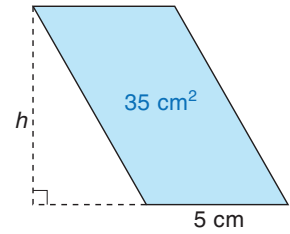
a) the height



b) the base



c) the height



7. Use 1-cm grid paper.

Draw a rectangle with the same area as each parallelogram in question 6.

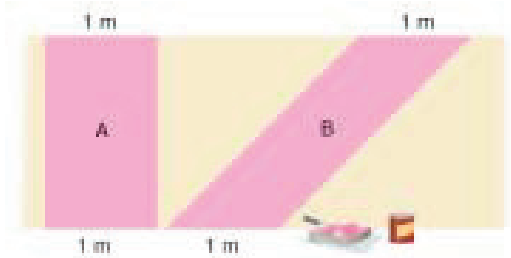
How many different ways can you do this?

8. Sasha is buying paint for a design on a wall.

Here is part of the design.

Sasha says figure B will need more paint than figure A.

Do you agree? Explain.



9. You will need 1-cm grid paper, ruler, and tracing paper.

Draw a parallelogram with base 10 cm and height 6 cm.

Draw a diagonal to make two triangles.

a) What do you notice about the two triangles?

How can you check your observation?

b) What is the area of the parallelogram?

c) What is the area of each triangle? How do you know?

Take It Further



10. A restaurant owner built a patio in front of his store to attract more customers.

a) What is the area of the patio?

b) What is the total area of the patio and gardens?

c) How can you find the area of the gardens?

Show your work.

Reflect

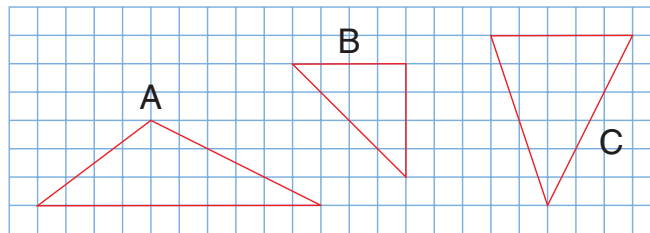
What do you need to know to find the area of a parallelogram?
Use an example to explain.

Explore

Work with a partner.

You will need a ruler and 1-cm grid paper.

Draw each triangle below on 1-cm grid paper.



- How many different ways can you find the area of each triangle? What strategies did you use?
- Use what you know about parallelograms. Find the area of each triangle.
- Use variables. Write a formula to find the area of a triangle.

Reflect & Share

How did you use a parallelogram to find the area of a triangle?

Compare your formula with that of another pair of classmates.

If the formulas are different, can both of them be used to find the area of a triangle? Explain.

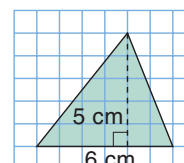
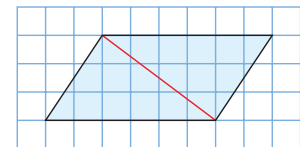
Connect

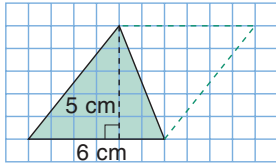
When we draw a diagonal in a parallelogram, we make 2 congruent triangles.

Congruent triangles have the same area.

So, the area of one triangle is $\frac{1}{2}$ the area of the parallelogram.

To find the area of this triangle:





Complete a parallelogram on one side of the triangle.

The area of the parallelogram is:

$$A = \text{base} \times \text{height, or } A = bh$$

$$\begin{aligned} \text{So, } A &= 6 \times 5 \\ &= 30 \end{aligned}$$

The area of the parallelogram is 30 cm^2 .

So, the area of the triangle is: $\frac{1}{2}$ of $30 \text{ cm}^2 = 15 \text{ cm}^2$

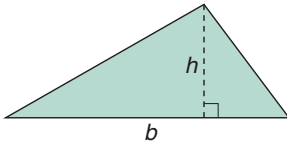
We can write a formula for the area of a triangle.

$$A = \frac{1}{2} \text{ base} \times \text{height}$$

$$A = \frac{1}{2} bh$$

$$\text{or } A = bh \div 2$$

$$\text{or } A = \frac{bh}{2}$$

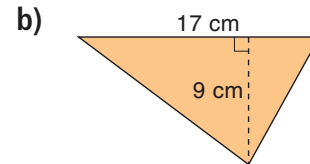
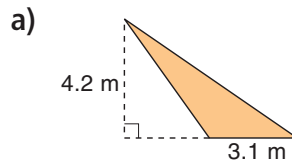


Example

For an obtuse triangle, the height might be drawn outside the triangle.

Solution

Find the area of each triangle.

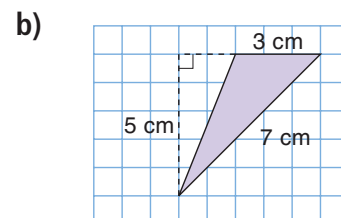
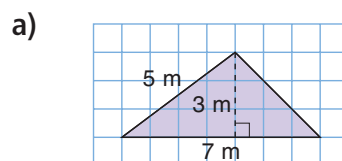


a) $A = \frac{bh}{2}$
 Substitute $b = 3.1$
 and $h = 4.2$.
 $A = \frac{3.1 \times 4.2}{2}$
 $A = 6.51$
 The area is 6.51 m^2 .

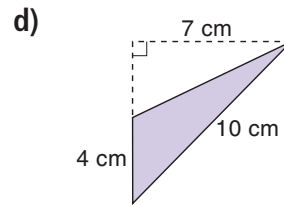
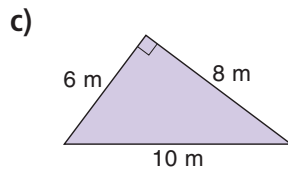
b) $A = \frac{bh}{2}$
 Substitute $b = 17$ and $h = 9$.
 $A = \frac{17 \times 9}{2}$
 $A = \frac{153}{2}$
 $= 76.5$
 The area is 76.5 cm^2 .

Practice

1. Identify one base and height of each triangle.

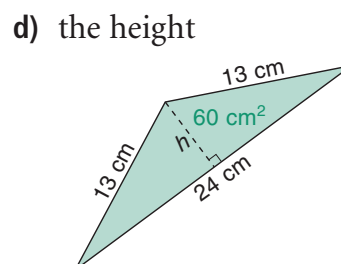
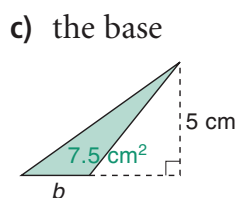
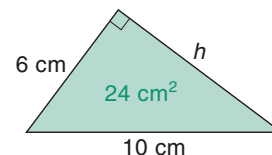
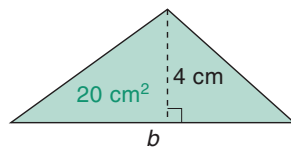


In a right triangle, one base and height are two sides of the triangle.



2. Find the area of each triangle in question 1.
3. a) On 1-cm grid paper, draw 3 different triangles with each base and height.
 - i) base: 4 cm; height: 3 cm ii) base: 7.5 cm; height: 6.5 cm
 b) Find the area of each triangle you drew in part a. What do you notice?
4. On 1-cm grid paper, draw two different triangles with each area.
 - a) 16 cm^2 b) 8 cm^2 c) 10 cm^2
5. Use 1-cm grid paper.
 - a) Draw a triangle with area 12 cm^2 .
 - b) Investigate the different ways you can draw a triangle that has:
 - i) double the area ii) one-half the area
 Write a report of your findings.
6. Use 1-cm grid paper.
 - a) Draw different triangles with base 4 cm and height 6 cm.
 - b) Find the area of each triangle you draw.
 - c) Measure the side lengths of each triangle you draw. How do you know all the triangles are different?

7. The area of each triangle is given. Find each unknown measure.
 - a) the base b) the height



Calculator Skills

Which is the best deal?
How do you know?

250 g cheese for \$2.99

400 g cheese for \$4.99

600 g cheese for \$6.79



Math Link

Your World

You use rulers and protractors to measure in the classroom.

Which measuring instruments do you have at home?

What do these instruments measure?

List all the instruments you can find.

Give an example of what each one measures.

8. When you know the area of a triangle, and its base, how can you find its height? Use an example to explain.

9. **Assessment Focus** The owner of a house paints this attic wall. There is a small rectangular window in the wall.

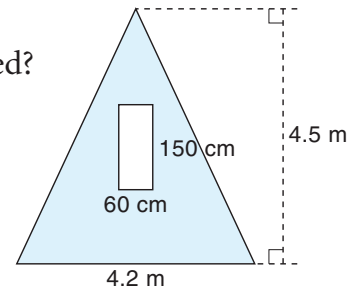
One litre of paint covers 6.5 m^2 .

- a) What is the area that is to be painted?

- b) The paint comes in 1-L cans.

How many cans does the owner need?

Explain your answer.



Take It Further

10. A local park has a pavilion to provide shelter.

The pavilion has a roof the shape of a rectangular pyramid.

- a) What is the total area of all four parts of the roof?

- b) One sheet of plywood is

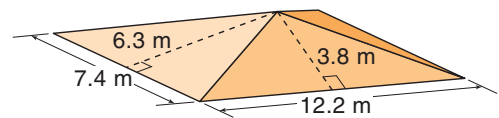
240 cm by 120 cm.

It costs \$24.95.

What is the least number of sheets of plywood needed to cover the roof?

What is the cost?

Explain how you got your answer.



Reflect

A triangle and a parallelogram have the same base and height.

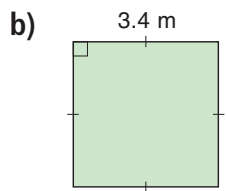
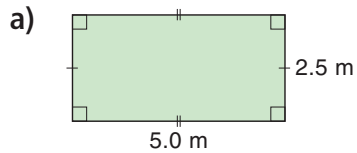
How are the areas of the triangle and parallelogram related?

Use an example to explain.

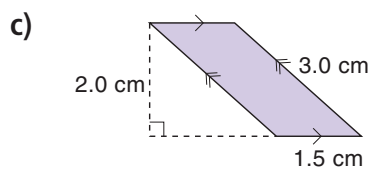
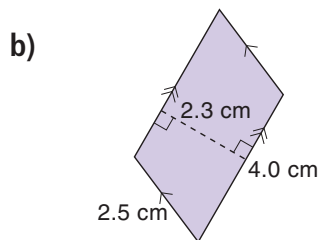
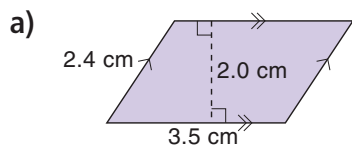
Mid-Unit Review

LESSON

- 6.1 1.** Find the perimeter and area of each figure.

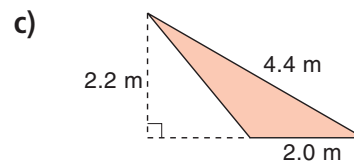
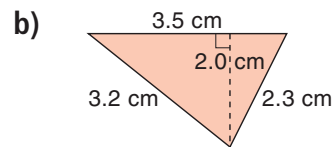
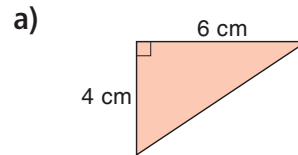


- 2.** Find the area of each parallelogram.

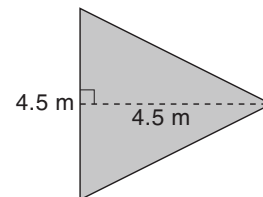


- 3.** A parallelogram has height 45 cm and base 60 cm.
- Find its area.
 - What is the base and height of a parallelogram with twice the area?
 - What is the base and height of a parallelogram with one-half the area?

- 6.2 4.** Find the area of each triangle.



- 5.** Po Ling is planning to pour a concrete patio beside her house. It has the shape of a triangle. The contractor charges \$125.00 for each square metre of concrete poured.



What will the contractor charge for the concrete?

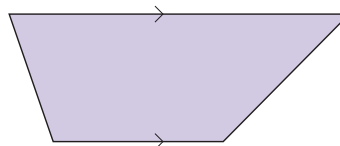


Focus Use a formula to find the area of a trapezoid.

This is a **trapezoid**.

How would you describe it?

Recall that a rectangle, a square, and a parallelogram are trapezoids, too.

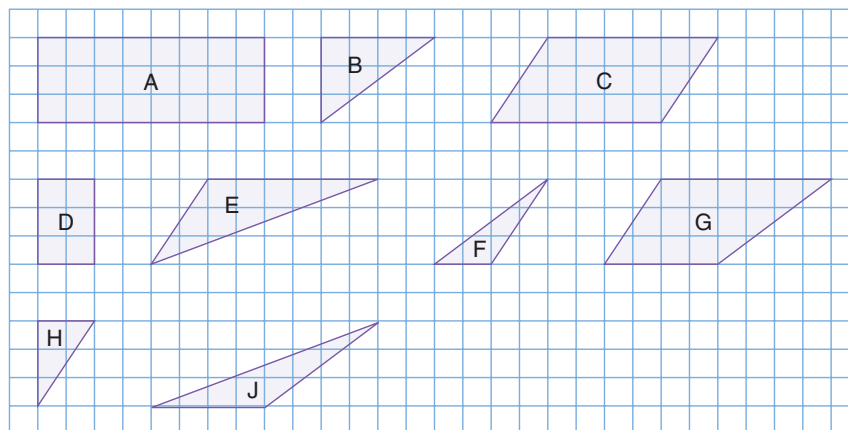


Explore

Work with a partner.

You will need scissors.

Your teacher will give you a copy of the figures below.



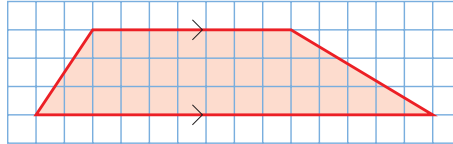
- Find the area of each figure.
- Cut out the figures.
- Identify the trapezoid that is not a parallelogram.
- How many different ways can you use the figures to find the area of the trapezoid?
- For each way you find, write a formula in words for the area of a trapezoid.
- Find the perimeter of the trapezoid.

Reflect & Share

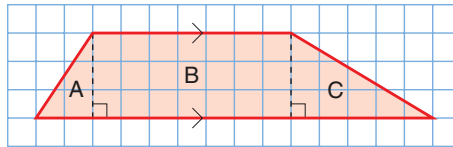
How did you use what you know about the areas of a triangle, a rectangle, and a parallelogram to find the area of a trapezoid?

Connect

We can find the area of a trapezoid by dividing it into other figures. Here are 3 ways to find the area of this trapezoid.

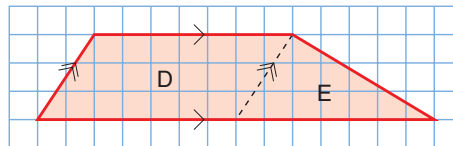


- Make 2 triangles and a rectangle.



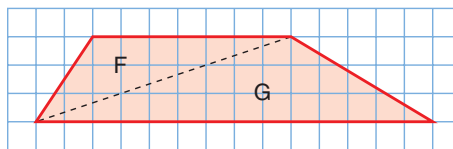
Area of trapezoid = area of triangle A + area of rectangle B
+ area of triangle C

- Make 1 triangle and a parallelogram.



Area of trapezoid = area of parallelogram D + area of triangle E

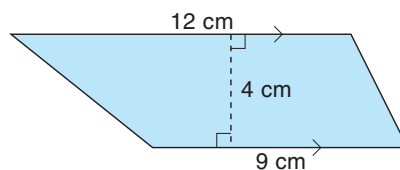
- Make 2 triangles.



Area of trapezoid = area of triangle F + area of triangle G

Example

- Estimate the area of this trapezoid.
- Calculate the area to check your estimate.

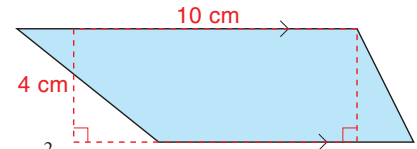


Solution

- a) Sketch a rectangle with width 4 cm and length between 9 cm and 12 cm, maybe 10 cm. The area of the rectangle is an estimate of the area of the trapezoid.

$$\begin{aligned} \text{Area of rectangle} &= 10 \times 4 \\ &= 40 \end{aligned}$$

The area of the trapezoid is about 40 cm^2 .



- b) Divide the trapezoid into 2 triangles.

$$\text{Area of triangle A} = \frac{bh}{2}$$

Substitute $b = 12$ and $h = 4$.

$$\begin{aligned} \text{So, area} &= \frac{12 \times 4}{2} \\ &= 24 \end{aligned}$$

$$\text{Area of triangle B} = \frac{bh}{2}$$

Substitute $b = 9$ and $h = 4$.

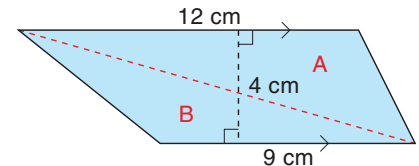
$$\begin{aligned} \text{So, area} &= \frac{9 \times 4}{2} \\ &= 18 \end{aligned}$$

Area of trapezoid = area of triangle A + area of triangle B

$$= 24 + 18$$

$$= 42$$

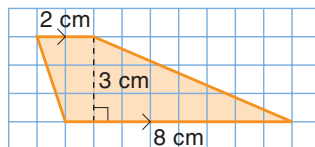
The area of the trapezoid is 42 cm^2 .



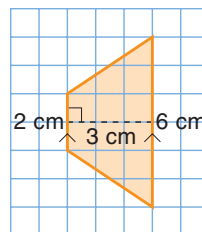
Practice

1. Find the area of each trapezoid by dividing it into 2 triangles.

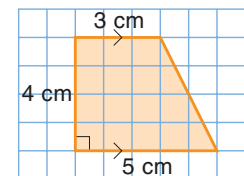
a)



b)

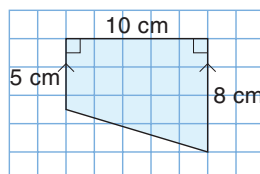


c)

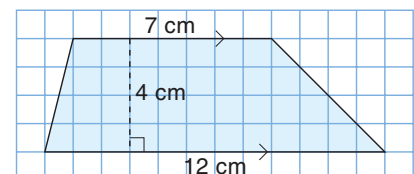


2. Find the area of each trapezoid by dividing it into 1 or 2 triangles and a rectangle.

a)



b)



Calculator Skills

Predict each product.
Check your prediction.

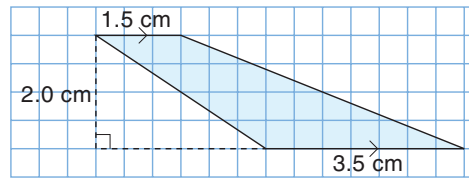
What patterns do you see
in the answers?

- 9×9
- 99×99
- 999×999
- 9999×9999

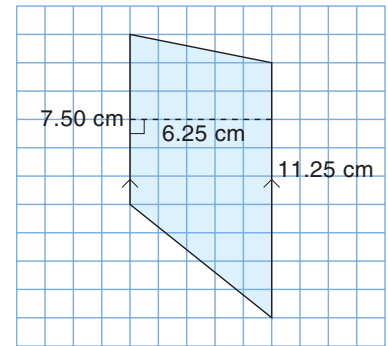
Use the pattern to
predict the product of
 $99\,999 \times 99\,999$.

3. Find the area of each trapezoid.

a)

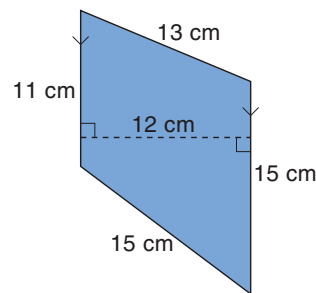


b)

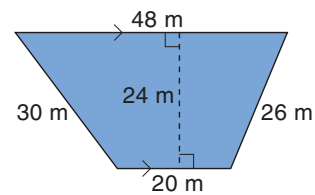


4. Find the area and perimeter of each trapezoid.

a)



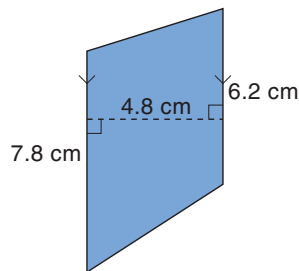
b)



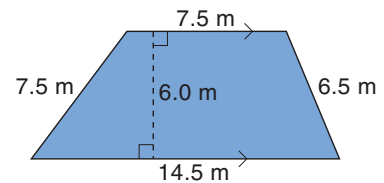
5. a) Estimate the area of each trapezoid.

Check your answer by calculating the area.

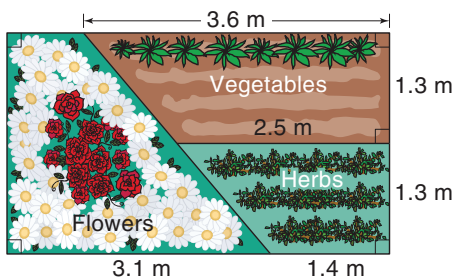
i)



ii)



b) Can you find the perimeter of each trapezoid in part a)?
Explain.



6. a) What is the area of each part of this garden?

b) Find the area of the whole garden two different ways.

7. Suppose you have a piece of string, 4 pushpins,
a ruler, and grid paper.

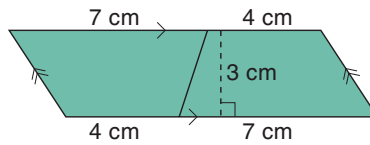
a) Describe how to make a trapezoid with
perimeter 20 cm.

Use your strategy to make the trapezoid.

b) Draw the trapezoid on grid paper.

c) Find the approximate area of the trapezoid.

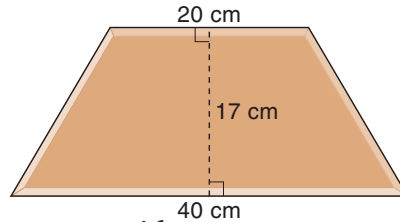
- 8. Assessment Focus** Two congruent trapezoids join to form a parallelogram.



- How can you use the area of the parallelogram to find the area of each trapezoid?
- Use grid paper. Draw a trapezoid. Use the area of a parallelogram to find the area of your trapezoid. Show your work.

Take It Further

- 9.** A patio is made with congruent brick tiles.



Each tile is a trapezoid.

- What is the area of the top face of each tile?
- Use red Pattern Blocks on triangular grid paper. Sketch a patio that uses these trapezoid tiles. How many tiles are in your patio?
- What is the area of your patio?
- When a patio is built, there is a 3-mm space between tiles for the grout. Would your completed patio be larger or smaller than the area you calculated in part c? Explain. How much larger or smaller would it be?



- 10.** Use any of the methods you know to find the area of a trapezoid. Use variables. Write a formula for the area of a trapezoid.

Reflect

How can you use the strategies for finding the area of a trapezoid to find the areas of a square, rectangle, and parallelogram? Use examples to explain.