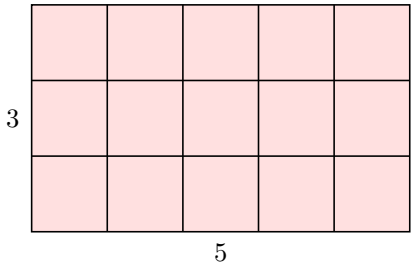
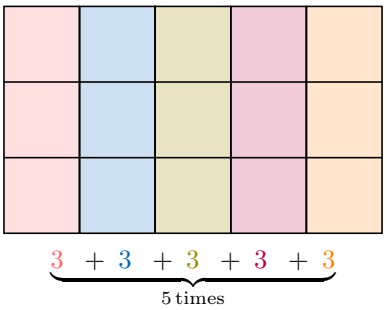
AREA FORMULAS

A AREA OF A RECTANGLE OR A SQUARE

Discover: Counting every single square to find the area can take a long time. Let's see if there is a shortcut. Consider a rectangle that is 5 units long and 3 units wide.



We can find its area by adding up the squares in each column.

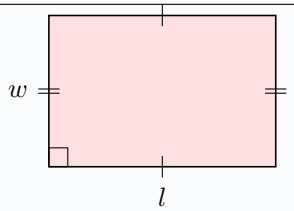
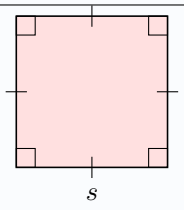


The area is $\underbrace{3 + 3 + 3 + 3 + 3}_{5 \text{ times}} = 5 \times 3 = 15$ square units.

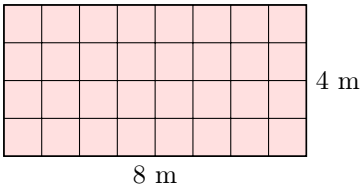
This shows that we can find the area of a rectangle by simply multiplying its **length** by its **width**.

Proposition **Area Formulas**

To find the area of a rectangle, multiply its **length** by its **width**.To find the area of a square, multiply the **side length** by itself.

Shape	Diagram	Area Formula
Rectangle		$A = l \times w$
Square		$A = s \times s$

Ex: Find the area of the rectangle:



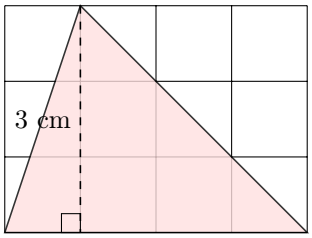
Answer: This is a rectangle with length $l = 8$ m and width $w = 4$ m. Using the formula for the area of a rectangle:

$$\begin{aligned} A &= l \times w \\ &= 8 \times 4 \\ &= 32\,\text{m}^2 \end{aligned}$$

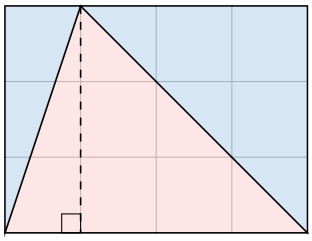
The area is 32 square meters (we read $32\,\text{m}^2$ as "32 square meters").

B AREA OF A TRIANGLE

Discover: To find the area of a triangle, we can cut it along its height to form two smaller triangles, then rearrange them to make a rectangle. Let's see how this works step by step with the triangle below:



1. Cut the triangle along the height CH to form two smaller triangles. Rotate and rearrange these two triangles to form a rectangle:



2. The area of the rectangle is the length multiplied by the height: $4 \times 3 = 12\,\text{cm}^2$. Since the area of the rectangle is equal to twice the area of the original triangle, the area of the triangle is half the area of the rectangle:

$$\begin{aligned} A_\triangle &= \frac{\text{base} \times \text{height}}{2} \\ &= \frac{4 \times 3}{2} \\ &= 6\,\text{cm}^2. \end{aligned}$$

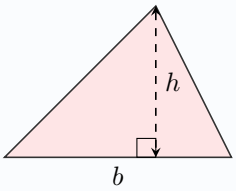
Proposition **Area of a Triangle**

The area of a triangle is found by multiplying the base by the height and dividing by 2:

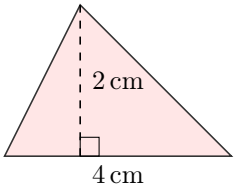
$$\text{Area of a triangle} = \frac{\text{base} \times \text{height}}{2}$$

$$A = \frac{b \times h}{2}$$

where b is the length of the base and h is the corresponding height.



Ex: Find the area of the triangle:



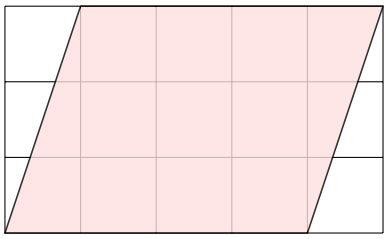
Answer:

$$\begin{aligned} A &= \frac{b \times h}{2} \\ &= \frac{4 \times 2}{2} \\ &= 4\,\text{cm}^2 \end{aligned}$$

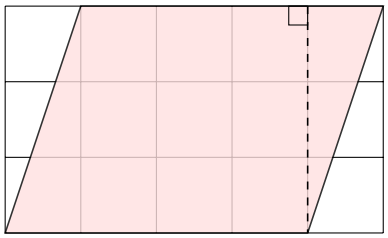
So, the area of the triangle is $4\,\text{cm}^2$.

C AREA OF A PARALLELOGRAM

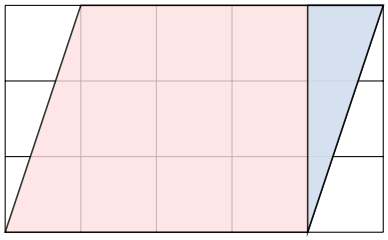
Discover: We can discover the formula for the area of a parallelogram by rearranging it into a rectangle.



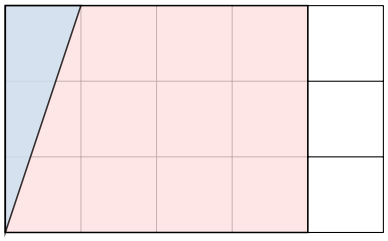
1. Draw the height, which is a line from the top side to the bottom side that is perpendicular to the base:



2. Cut the triangle on the right side:



3. Move the triangle to the left side to form a rectangle:



4. Now we have a rectangle with a length (base) of 4 cm and a height of 3 cm. The area of the parallelogram is the same as the area of this rectangle, which is the base times the height: $4 \times 3 = 12\,\text{cm}^2$.

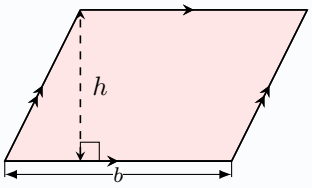
Proposition **Area of a Parallelogram**

The area of a parallelogram is found by multiplying the base by the height:

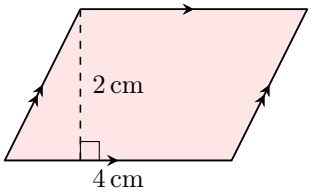
$$\text{Area of a parallelogram} = \text{base} \times \text{height}$$

$$A = b \times h,$$

where b is the base and h is the height.



Ex: Find the area of the parallelogram:



Answer:

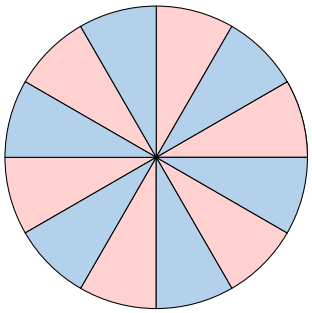
$$\begin{aligned} A &= b \times h \\ &= 4 \times 2 \\ &= 8\,\text{cm}^2 \end{aligned}$$

So, the area of the parallelogram is $8\,\text{cm}^2$.

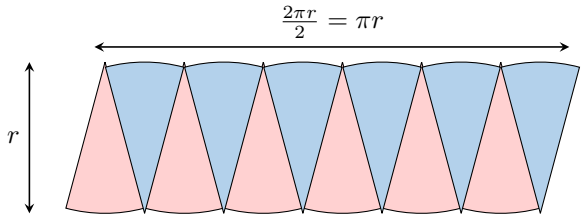
D AREA OF A CIRCLE

Discover: To find the area of a circle, we can divide it into smaller parts and rearrange them to approximate a parallelogram. Let's see how this works step by step:

1. Divide the circle into 12 equal parts, like slices of a pie:



2. Imagine cutting these 12 parts from the circle.
3. Rearrange the parts by alternating them to form a shape that looks like a parallelogram:



4. The base of the parallelogram is approximately half the circumference of the circle (πr), and its height is approximately the radius (r). So, the area of the circle is the area of the parallelogram:

$$\begin{aligned} A_{\text{circle}} &= (\pi r) \times r \\ &= \pi \times r \times r \\ &= \pi r^2. \end{aligned}$$

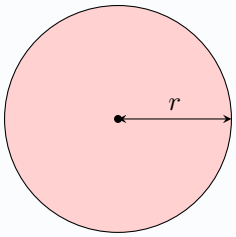
We read this as "pi r squared".

Proposition Area of a Circle

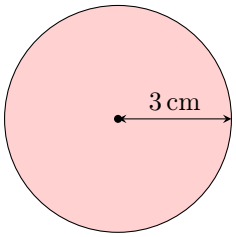
The area of a circle is found by multiplying pi by the radius squared:

$$\text{Area of a circle} = \pi \times \text{radius} \times \text{radius}$$

$$A = \pi r \times r = \pi r^2$$



Ex: Find the area of the circle:



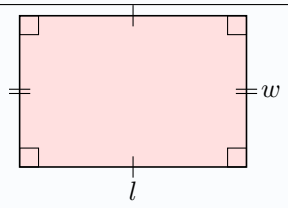
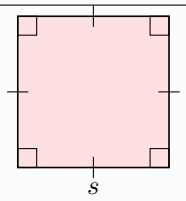
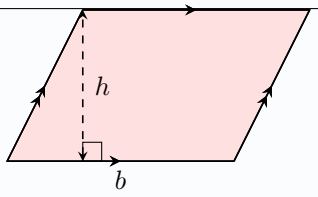
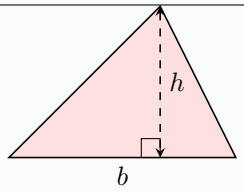
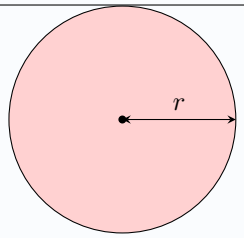
Answer:

$$\begin{aligned} A &= \pi \times r \times r \\ &= \pi \times 3 \times 3 \\ &= 9\pi \\ &\approx 28.3\,\text{cm}^2 \quad (\text{using } \pi \approx 3.14) \end{aligned}$$

E AREA FORMULAS

Proposition Area Formulas

Here are the area formulas for some common shapes.

Name	Shape	Area
Rectangle		$A = l \times w$
Square		$A = s \times s$ $= s^2$
Parallelogram		$A = b \times h$
Triangle		$A = \frac{b \times h}{2}$
Circle		$A = \pi \times r \times r$ $= \pi r^2$

F AREA OF COMPOSITE FIGURES

Definition Composite Figure

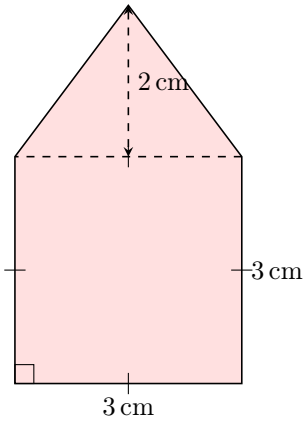
A **composite figure** is made up of two or more simple geometric shapes, like rectangles, triangles, or circles, combined together.

Method Finding the Area of a Composite Figure

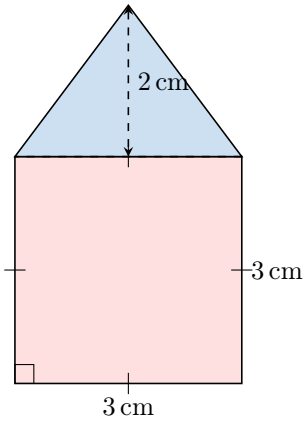
To find the area of a composite figure, follow these steps:

1. Divide the figure into simple, non-overlapping shapes, such as rectangles, triangles, or circles.
2. Find the area of each simpler shape using the appropriate formula.
3. Add the areas together to find the total area of the composite figure.

Ex: Find the area of the composite figure below, which is made up of a square and a triangle:



Answer:



$$
\begin{aligned}
A &= \text{Area of square} + \text{Area of triangle} \\
&= s \times s + \frac{b \times h}{2} \\
&= 3 \times 3 + \frac{3 \times 2}{2} \\
&= 9 + 3 \\
&= 12\,\text{cm}^2
\end{aligned}
$$