LENGTH

A LENGTH UNITS

Discover: We can measure length in many ways, for example with our footsteps or with paper clips. But everyone's footsteps and paper clips are different sizes! How can we share our measurements if we all use different units?
To solve this, people all around the world agreed to use the same units. We call these **standard units**. One very common standard unit for length is the **meter**.

Definition **Units of Length**

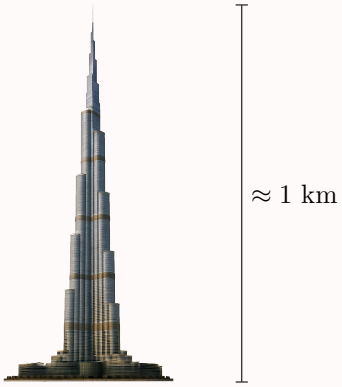
We use different units for measuring small and large things.

- **Millimeter** (mm): A very small unit of length, about the thickness of a coin.

- **Centimeter** (cm): A small unit of length, about the width of your finger.

- **Meter** (m): A longer unit of length, about the height of a 6-year-old girl.

- **Kilometer** (km): A very large unit of length, used for long distances, like the distance between towns. It is about the height of the Burj Khalifa in Dubai, United Arab Emirates.



B CONVERSION OF LENGTH UNITS

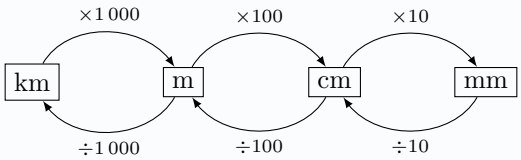
Definition Conversion of Length Units

Here are some useful metric conversions:

- 1 **km** = 1 000 **m**
- 1 **m** = 100 **cm**
- 1 **cm** = 10 **mm**

Method Converting with Multiplication or Division

- Use **multiplication** when you go from a **bigger** unit to a **smaller** one (e.g., m → cm).
- Use **division** when you go from a **smaller** unit to a **bigger** one (e.g., cm → m).



Method Converting Using a Table

To convert between units of length, we can use a metric place value table. This table shows the main metric units from kilometers to millimeters. Each column represents one step of 10 or 100 or 1 000 between units. Let's convert **1.2 meters** to **centimeters**.

1. **Draw the full metric place value table.**

km			m		cm	mm

2. **Place the number in the table.**
The rule is: the digit in the **ones place** goes in the starting unit's column.
For 1.2 m, the ones digit is 1, so it goes in the **m** column. The digit 2 (the tenths) goes in the next column to the right.

km			m		cm	mm
			1	**2**		

3. **Fill any empty spaces with zeros** until you reach your target unit.
Our target unit is **cm**, so we put a 0 in the **cm** column.

km			m		cm	mm
			1	2	**0**	

4. **Read the final number.**
Now read the digits as a number in centimeters:

$$1.2 \text{ m} = 120 \text{ cm}.$$

This matches the fact that we multiply by 100 when converting m to cm.

C PERIMETER

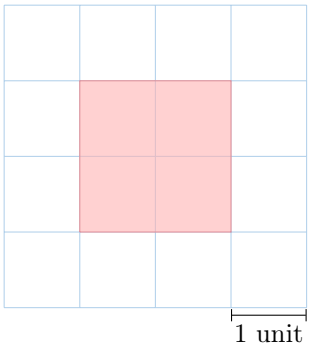
Definition Perimeter

The **perimeter** of a shape is the total distance all the way around its outside edge.

Method Finding the perimeter

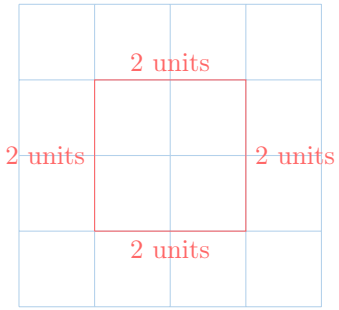
To find the perimeter of any shape, **add the lengths of all its sides** together.

Ex: Find the perimeter of the red shape. Each square on the grid is 1 unit long.



Answer:

- **Step 1:** Find the length of each side by counting the units on the grid.



The sides are 2 units, 2 units, 2 units, and 2 units long.

- **Step 2:** Add the lengths of all the sides.

$$\begin{aligned}\text{Perimeter} &= 2+2+2+2\\ &= 8\end{aligned}$$

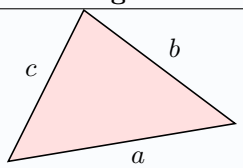
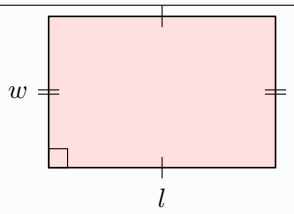
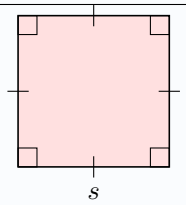
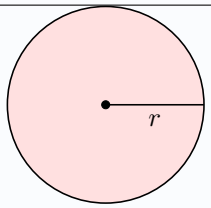
The perimeter of the shape is **8 units**.

D PERIMETER OF COMMON SHAPES

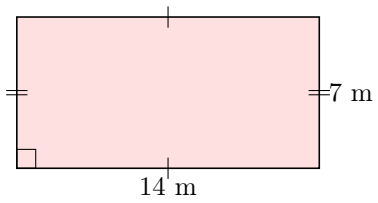
Method Finding a Polygon's Perimeter

To find the perimeter of any polygon (a closed shape with straight sides), add up the lengths of all its sides.

Proposition **Perimeter Formulas**

Shape	Diagram	Perimeter Formula
Triangle		$P = a + b + c$
Rectangle		$P = l + w + l + w$ $= 2l + 2w$ $= 2(l + w)$
Square		$P = s + s + s + s = 4s$
Circle		$P = 2\pi r$

Ex: Find the perimeter of the rectangle:



Answer: The rectangle has a length $l = 14$ m and a width $w = 7$ m. We can use either perimeter formula.

- **Method 1 (add both pairs of equal sides):**

$$\begin{aligned} P &= 2 \times l + 2 \times w \\ &= 2 \times 14 + 2 \times 7 \\ &= 28 + 14 \\ &= 42\,\text{m} \end{aligned}$$

- **Method 2 (factorise):**

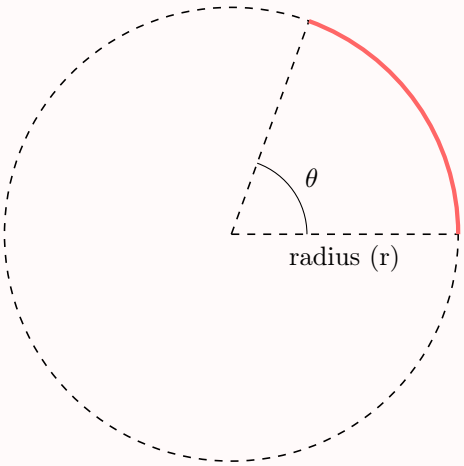
$$\begin{aligned} P &= 2 \times (l + w) \\ &= 2 \times (14 + 7) \\ &= 2 \times 21 \\ &= 42\,\text{m} \end{aligned}$$

The perimeter of the rectangle is 42 **m**.

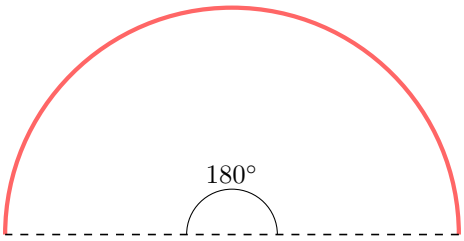
E LENGTH OF AN ARC

Definition Arc of a Circle

An **arc** is a part of the circumference of a circle, between two points on the circle, defined by its central angle θ (theta).



Ex: A semicircle is an arc with a central angle of 180°.



Method Finding the Length of an Arc

To find the length of an arc, you take a fraction of the full circumference.

1. **Find the fraction of the circle.** This is the arc's central angle (in degrees) divided by 360°:

$$\text{Fraction} = \frac{\text{central angle } (\theta)}{360°}.$$

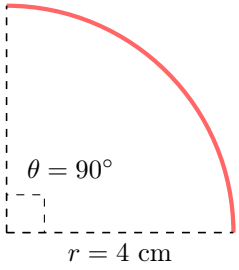
2. **Multiply the fraction by the full circumference.** Remember, the circumference of a circle with radius r is $C = 2\pi r$:

$$\text{Arc Length} = \text{Fraction} \times (2\pi r).$$

So, if the central angle is θ (in degrees) and the radius is r,

$$\text{Arc Length} = \frac{\theta}{360°} \times 2\pi r.$$

Ex: Find the length of the arc in the figure below.



Answer: We will follow the two-step method. The given values are $\theta = 90°$ and $r = 4$ cm.

1. **Step 1: Find the fraction of the circle.**

$$\text{Fraction} = \frac{90°}{360°} = \frac{1}{4}.$$

2. **Step 2: Multiply the fraction by the full circumference.**

$$\begin{aligned}\text{Arc Length} &= \frac{1}{4} \times (2 \times \pi \times r) \\ &= \frac{1}{4} \times (2 \times \pi \times 4) \\ &= \frac{1}{4} \times 8\pi \\ &= 2\pi \text{ cm}.\end{aligned}$$

The **exact length** of the arc is 2π cm. For an approximate value, we use a calculator:

$$\text{Arc Length} \approx 6.28 \text{ cm}.$$

F PERIMETER OF COMPOSITE FIGURES

Definition Composite Figure

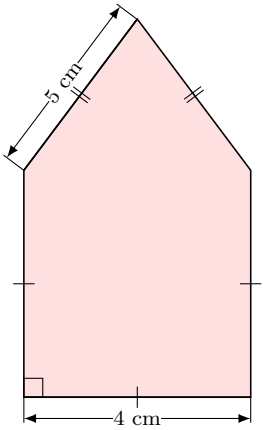
A **composite figure** is a shape made by joining two or more simple shapes (like rectangles, squares, and triangles).

Method Finding the Perimeter of a Composite Figure

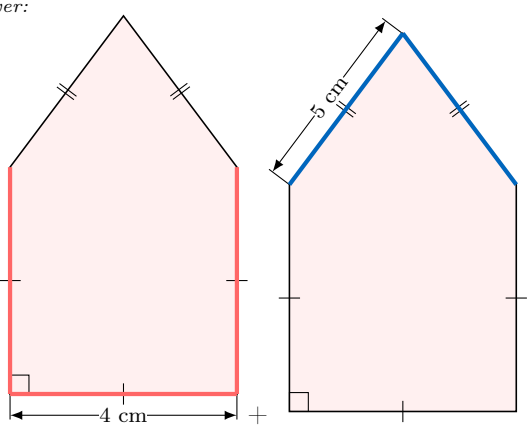
To find the perimeter of a composite figure:

1. Identify all the **outer sides** of the figure. Be careful not to include any lines inside the shape.
2. **Find the lengths of any unknown sides.** You may need to use information from the other sides to figure these out.
3. **Add the lengths** of all the outer sides together.

Ex: Find the perimeter of this composite figure, which is made of a square and a triangle.



Answer:



$P =$ +

$P = 3 \times 4 \text{ cm} + 2 \times 5 \text{ cm}$

$P = 22 \text{ cm}$