LENGTH

A LENGTH UNITS

> **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.
>
> ≈ 1 mm
>
> - **Centimeter** (cm): A small unit of length, about the width of your finger.
>
> ≈ 1 cm
>
> - **Meter** (m): A longer unit of length, about the height of a 6-year-old girl.
>
> ≈ 1 m
>
> - **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.
>
> ≈ 1 km
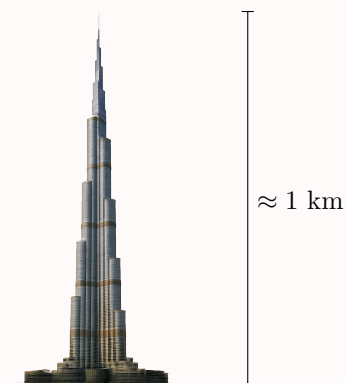
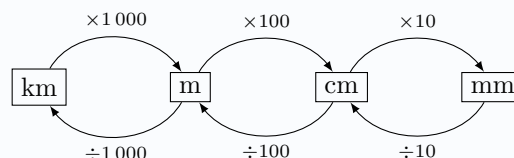# B CONVERSION OF LENGTH UNITS

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).

$$\times 1\,000 \qquad \times 100 \qquad \times 10$$

| km | m | cm | mm |

$$\div 1\,000 \qquad \div 100 \qquad \div 10$$

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.
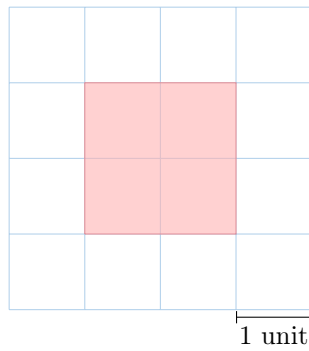
C PERIMETER

Definition Perimeter

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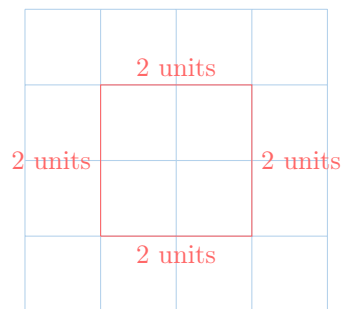
Method Finding the perimeter

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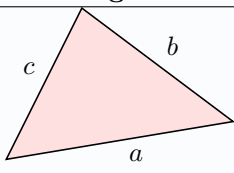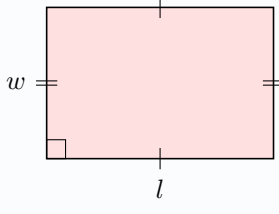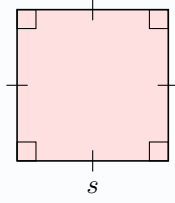
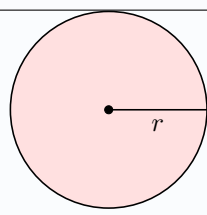- **Step 2:** Add the lengths of all the sides.

$$\text{Perimeter} = 2 + 2 + 2 + 2$$
$$= 8$$

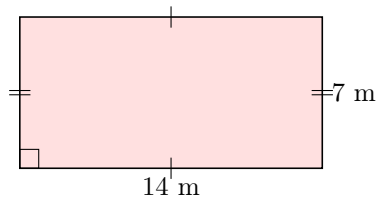The perimeter of the shape is **8 units**.

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.

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):**

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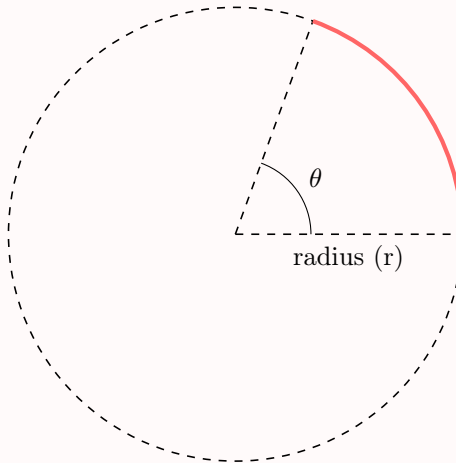$$

- **Method 2 (factorise):**

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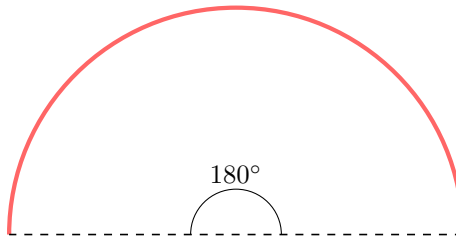$$

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).
>
>
>
> radius (r)

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

$180°$

> **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 $360°$:
>
> $$\text{Fraction} = \frac{\text{central angle } (\theta)}{360°}.$$
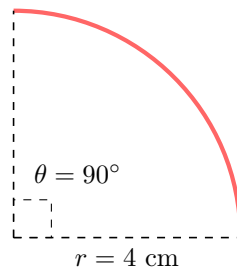>
> 2. **Multiply the fraction by the full circumference.** Remember, the circumference of a circle with radius r is $C = 2\pi r$:
>
> $$\text{Arc Length} = \text{Fraction} \times (2\pi r).$$
>
> So, if the central angle is θ (in degrees) and the radius is r,
>
> $$\text{Arc Length} = \frac{\theta}{360°} \times 2\pi r.$$

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

$\theta = 90°$

$r = 4$ cm

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.**

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

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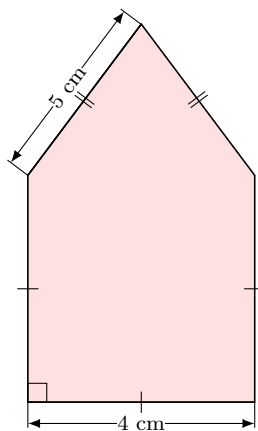
> Definition **Composite Figure**
>
> A **composite figure** is a shape made by joining two or more simple shapes (like rectangles, squares, and triangles).

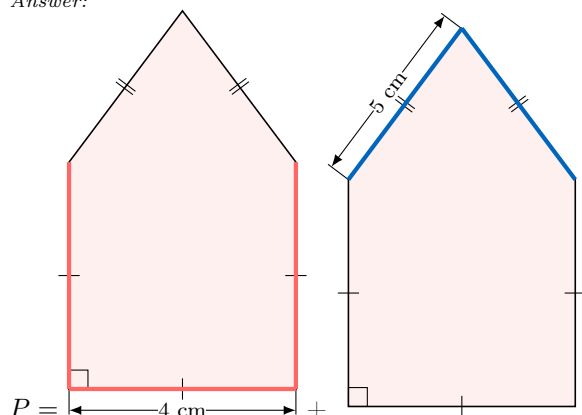> Method **Finding the Perimeter of a Composite Figure**
>
> To find the perimeter of a composite figure:
>
> 1. Identify all the **outer sides** of the figure. Be careful not to include any lines inside the shape.
>
> 2. **Find the lengths of any unknown sides.** You may need to use information from 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 = $ ⊢——4 cm——⊣ $+$

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

$P = 22 \text{ cm}$