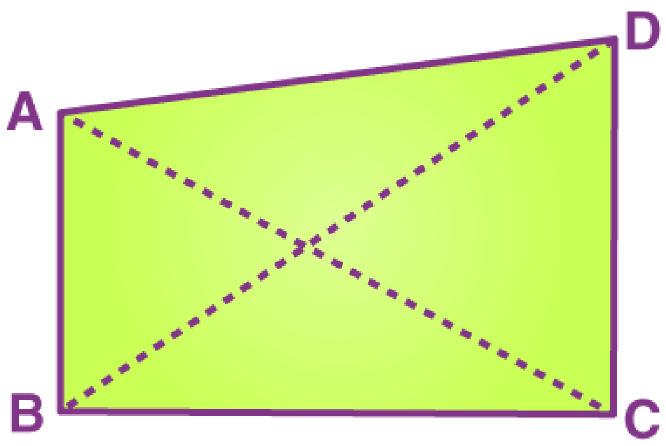
Understanding Quadrilaterals Class 8 Notes- Chapter 3

Introduction to Class 8 Understanding Quadrilaterals

In class 8, the chapter "Understanding Quadrilaterals", will discuss the fundamental concepts related to quadrilaterals, different types of quadrilaterals and their properties, different types of curves, polygons and some of the theorems related to quadrilaterals such as angle sum property of quadrilaterals, and so on, with complete explanation.

What are Quadrilaterals?

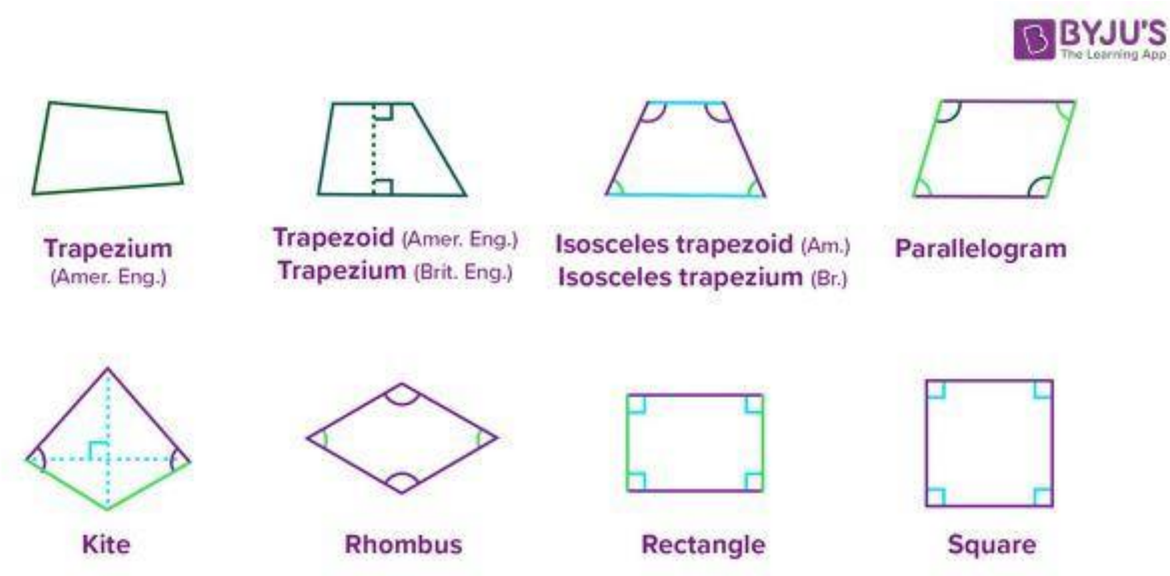
Quadrilaterals are one type of polygon which has four sides and four vertices and four angles along with 2 diagonals. There are various types of quadrilaterals.



Types of Quadrilaterals

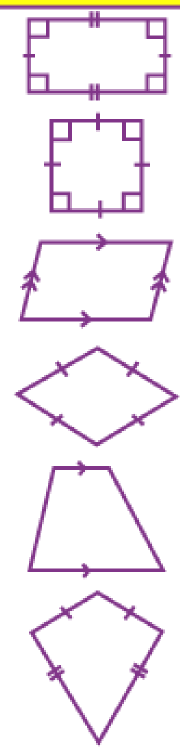
The classification of quadrilaterals are dependent on the nature of sides or angles of a quadrilateral and they are as follows:

- Trapezium
- Kite
- Parallelogram
- Square
- Rectangle
- Rhombus



The figure given below represents the properties of different quadrilaterals.

Quadrilateral	Properties
Rectangle	4 right angles and opposite sides equal
Square	4 right angles and 4 equal sides
Parallelogram	Two pairs of parallel sides and opposite sides equal
Rhombus	Parallelogram with 4 equal sides
Trapezoid	Two sides are parallel
Kite	Two pairs of adjacent sides of the same length



Revisiting Geometry

As we know, Geometry is one of the branches of Mathematics that deals with the study of different types of shapes, their properties, and how to construct lines, angles and different polygons. Geometry is broadly classified into plane geometry (two-dimensional) and solid geometry (three-dimensional geometry).

Introduction to Curves

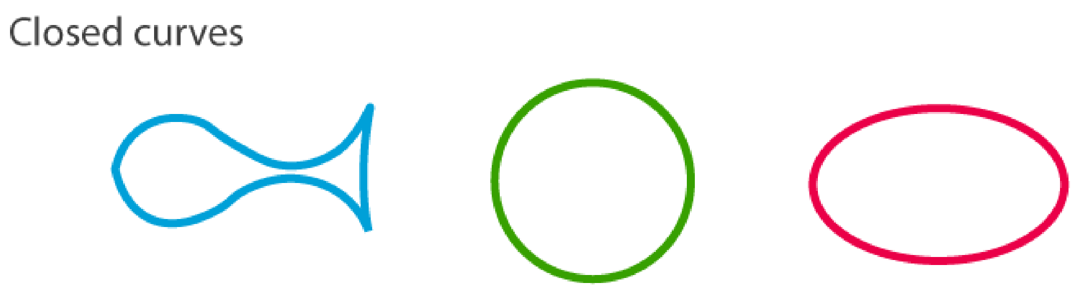
A **curve** is a geometrical figure obtained when a **number of points** are joined without **lifting** the pencil from the paper and **without retracing** any portion. It is basically a **line** which **need not be straight**.

The various types of curves are:

- Open curve: An **open curve** is a curve in which there is **no path** from any of its point to the **same point**.
- Closed curve: A **closed curve** is a curve that forms **a path** from any of its point to the **same point**.

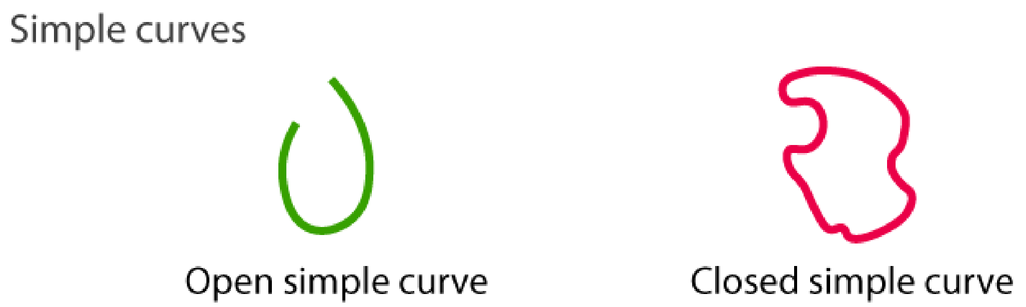
A curve can be:

- A closed curve:



- An open curve:

- Simple open and closed curves:



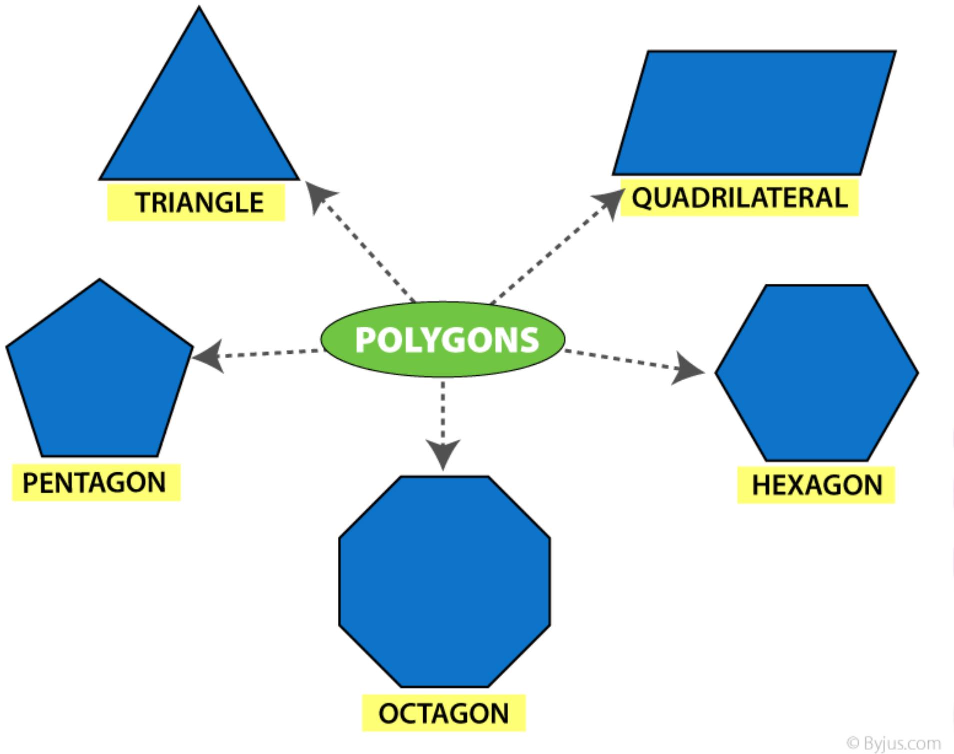
Polygons

A simple **closed curve** made up of only **line segments** is called a **polygon**.
Various examples of polygons are Squares, Rectangles, Pentagons etc.
Note:
The sides of a polygon do not cross each other.

Classification of Polygons on the Basis of Number of Sides / Vertices

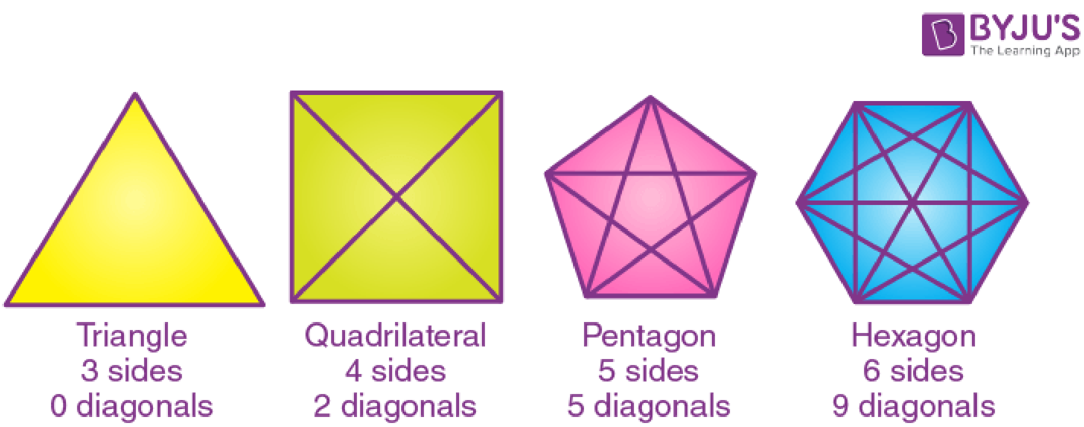
Polygons are classified according to the number of sides they have. The following lists the different types of polygons based on the number of sides they have:

- When there are three sides, it is **triangle**
- When there are four sides, it is **quadrilateral**
- When there are five sides, it is **pentagon**
- When there are six sides, it is **hexagon**
- When there are seven sides, it is **heptagon**
- When there are eight sides, it is **octagon**
- When there are nine sides, it is **nonagon**
- When there are ten sides, it is **decagon**



Diagonals

A **diagonal** is a line segment connecting two **non-consecutive vertices** of a **polygon**.

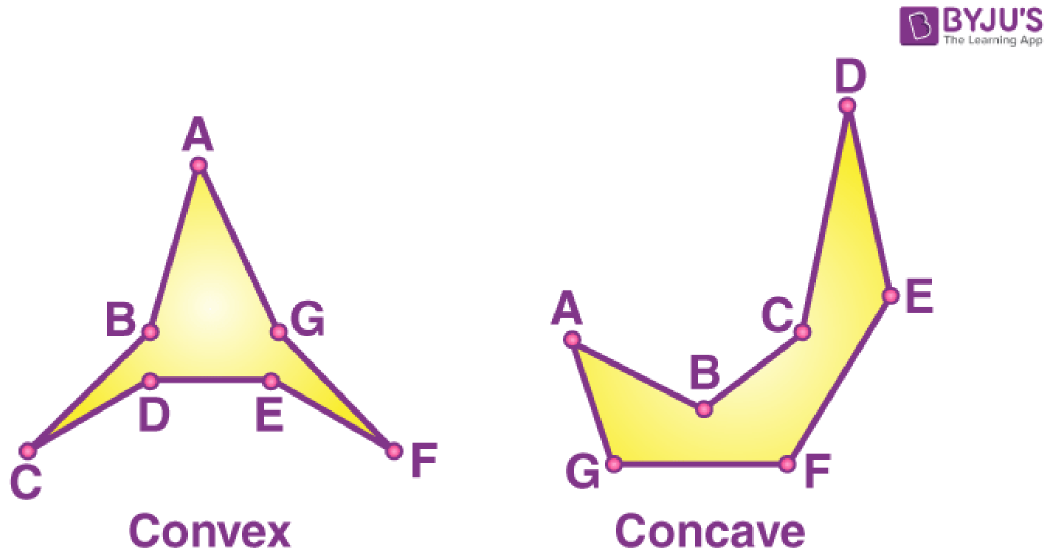


Polygons on the Basis of Shape

Polygons can be classified as **concave** or **convex** based on their shape.

- A **concave** polygon is a polygon in which at least one of its **interior angles** is **greater than 90**°. Polygons that are **concave** have at least **some portions of their diagonals** in their **exterior**.

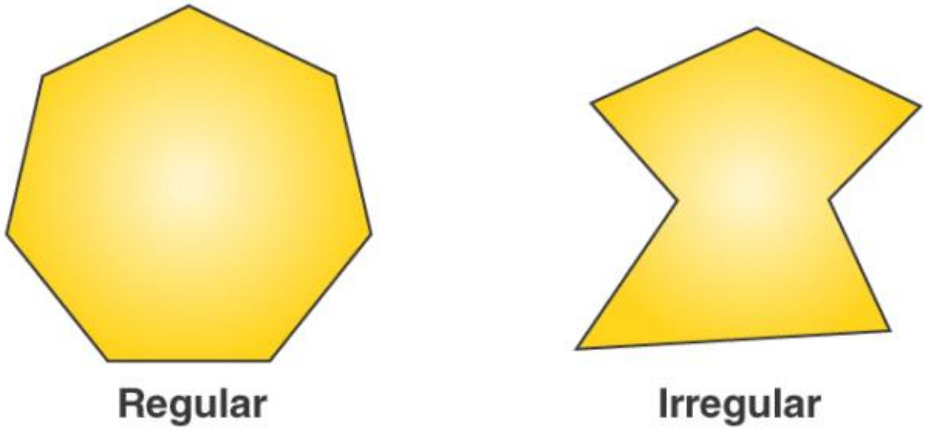
- A **convex** polygon is a polygon with all its **interior angle less than 180◦**. Polygons that are **convex** have **no portions** of their **diagonals** in their **exterior**.



Polygons on the Basis of Regularity

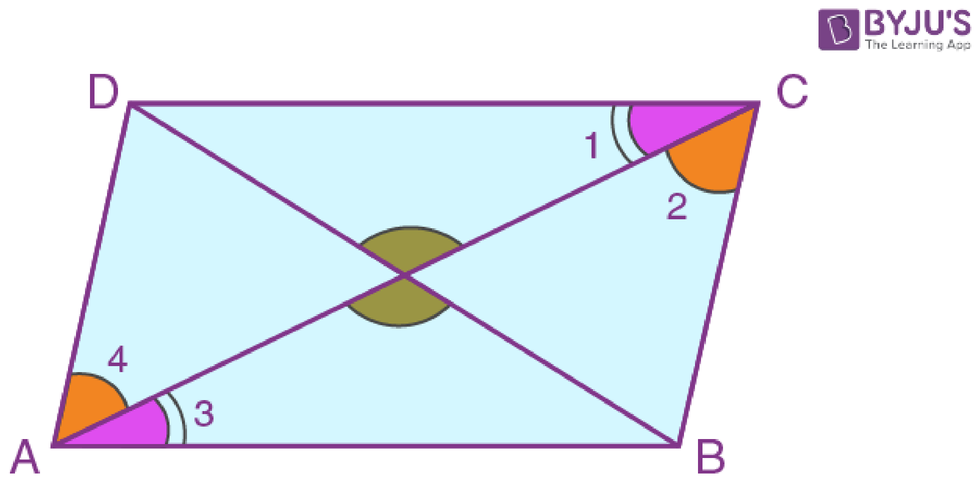
Polygons can also be classified as **regular polygons** and **irregular polygons** on the basis of regularity.

- When a polygon is both **equilateral** and **equiangular** it is called as a regular polygon. In a regular polygon, all the sides and all the angles are equal. Example: Square
- A polygon which is not regular i.e. it is not equilateral and equiangular, is an irregular polygon. Example: Rectangle

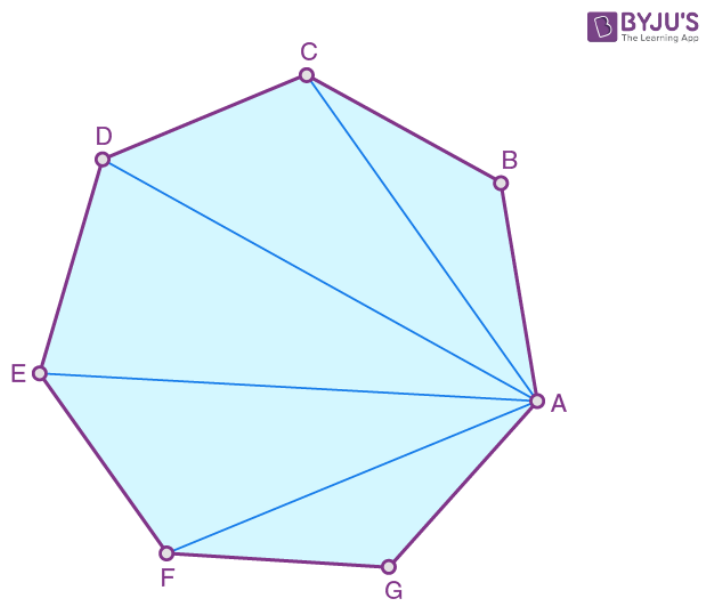


Angle Sum Property of a Polygon

According to the **angle sum property** of a polygon, the **sum of all the interior angles** of a polygon is equal to $(n-2)\times180°$, where n is the number of sides of the polygon.



As we can see for the above quadrilateral, if we join one of the diagonals of the quadrilateral, we get two triangles.
The sum of all the interior angles of the two triangles is equal to the sum of all the interior angles of the quadrilateral, which is equal to 360∘ = (4−2)×180°.
So, if there is a polygon which has ***n* sides**, we can make **(*n* – 2) non-overlapping triangles** which will perfectly cover that polygon.

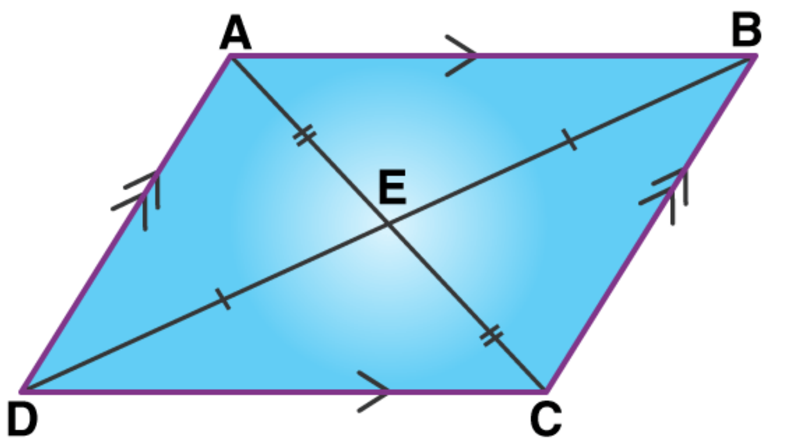


The **sum of the interior angles of the polygon** will be equal to the **sum of the interior angles of the triangles** = (n−2)×180°.

Sum of Measures of Exterior Angles of a Polygon

The **sum** of the measures of the **external angles** of any **polygon** is **360°**.

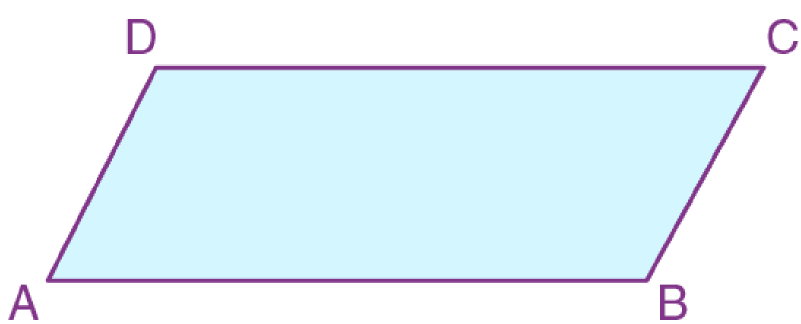
Properties of Parallelograms



The following are the important properties of parallelogram:

1. The opposite sides of a parallelogram are equal and congruent.
2. Diagonals of a parallelogram bisect each other.
3. The diagonals of parallelogram bisect each other and produce two congruent triangles
4. The opposite angles of a parallelogram are congruent.

Elements of a Parallelogram

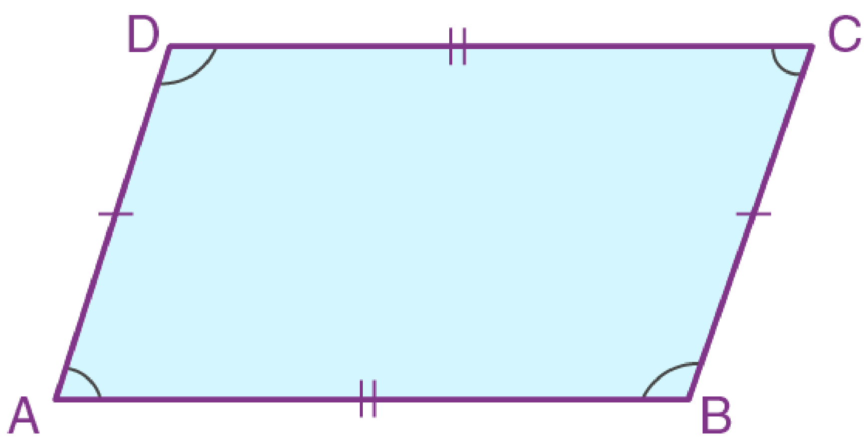


- There are **four sides** and **four angles** in a parallelogram.
- The **opposite sides** and **opposite angles** of a parallelogram are **equal**.
- In the parallelogram ABCD, the sides $\overline{AB}$ and $\overline{CD}$ are **opposite** sides and the sides $\overline{AB}$ and $\overline{BC}$ are **adjacent sides**.
- Similarly, ∠ABC and ∠ADC are **opposite angles** and ∠ABC and ∠BCD are **adjacent angles**.

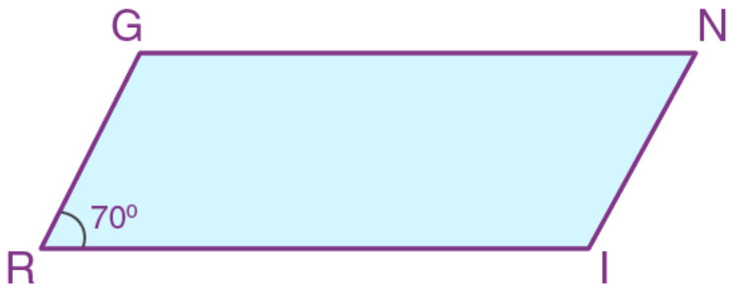
Angles of a Parallelogram

The **opposite angles** of a parallelogram are **equal**.
In the parallelogram ABCD, ∠ABC=∠ADC and ∠DAB=∠BCD.

The **adjacent angles** in a parallelogram are **supplementary**.
∴ In the parallelogram ABCD, ∠ABC+∠BCD=∠ADC+∠DAB=180°



For example,



In the given parallelogram (RING), ∠R = 70°. Now, we have to find the remaining angles.

As we know, the opposite angles of a parallelogram are equal, we can write:

∠R = ∠N = 70°.

And we know, the adjacent angles of a parallelogram are supplementary, we get

∠R + ∠I = 180°

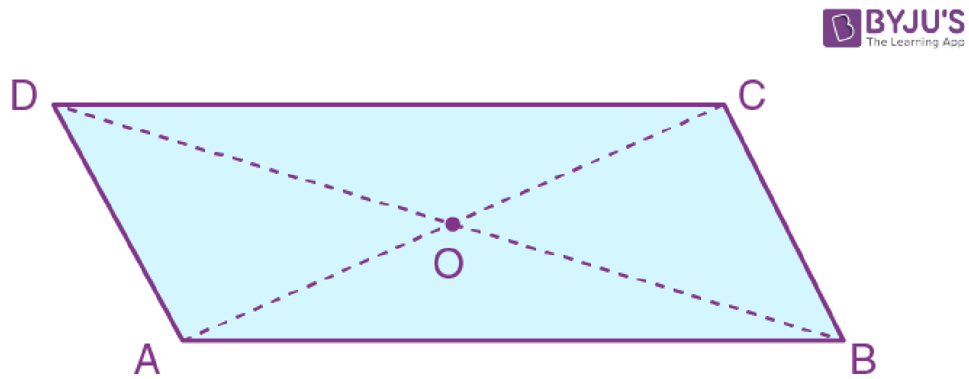
Hence, ∠I = 180° – 70° = 110°

Therefore, ∠I = ∠G = 110° [Since ∠I and ∠G are opposite angles]

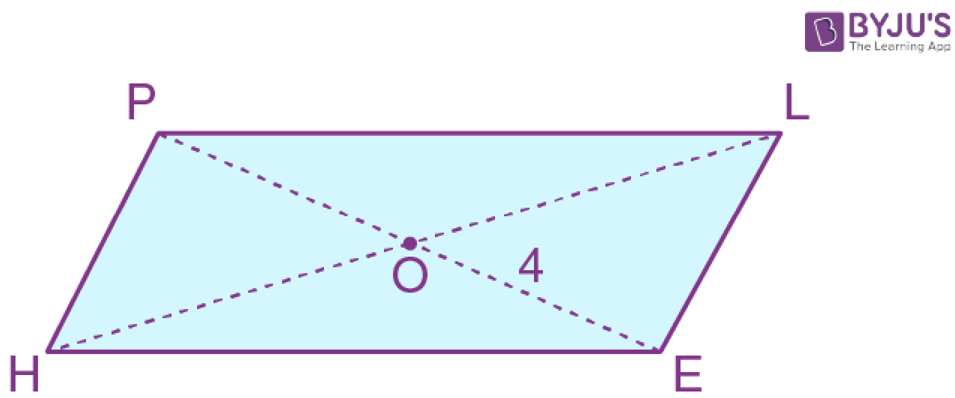
Hence the angles of a parallelogram are ∠R = ∠N = 70° and ∠I = ∠G = 110°.

Diagonals of a Parallelogram

The **diagonals** of a parallelogram **bisect** each other at the point of intersection.
In the parallelogram ABCD given below, OA = OC and OB = OD.



Consider an example, if OE = 4cm and HL is five more than PE, find the measure of OH.



Given that, OE = 4 cm and hence, OP = 4cm [Since OE = OP]

Hence PE =OE + OP = 4cm + 4cm = 8 cm

Also given that, HL is 5 more than PE,

Hence, HL = 5 + 8 = 13 cm.

Therefore, OH = HL/2 = 13/2 = 6.5 cm

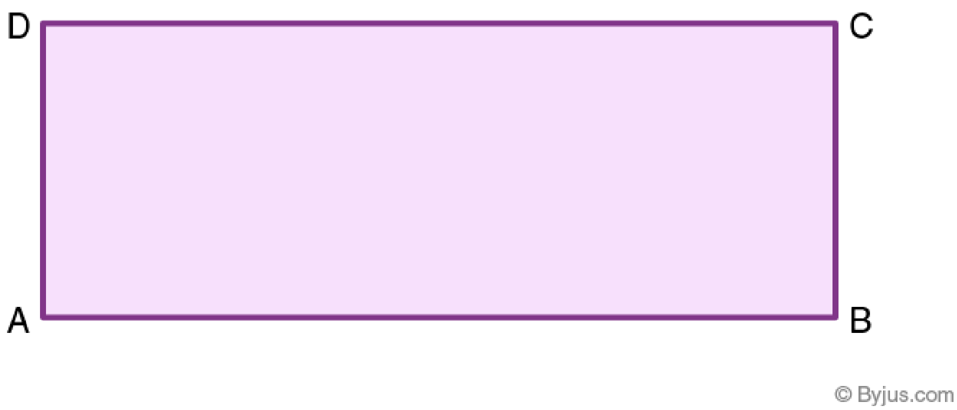
Therefore, the measurement of OH is 6.5 cm

Properties of Special Parallelograms

Rectangle

A **rectangle** is a **parallelogram** with **equal angles** and each angle is **equal to 90°**.
Properties:

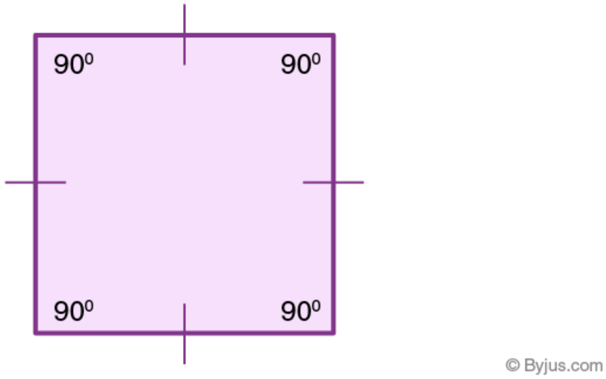
- **Opposite sides** of a rectangle are **parallel** and **equal**.
- The length of **diagonals** of a rectangle is **equal**.
- All the **interior angles** of a rectangle are **equal to 90°**.
- The **diagonals** of a rectangle **bisect** each other at the point of intersection.



Square

A **square** is a **rectangle** with **equal sides**. All the properties of a rectangle are also true for a square.
In a square the diagonals:

- bisect one another
- are of equal length
- are perpendicular to one another



Rhombus

Rhombus is one of the special cases of parallelogram. In Rhombus, all the sides are equal and the opposite sides are also equal.