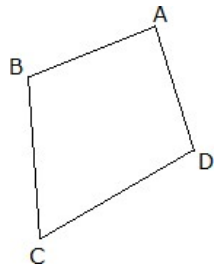
Education that enlightens!

Quadrilaterals

1. What is a quadrilateral?

A **quadrilateral** is a closed figure obtained by joining four points (with no three points collinear) in an order.



Here, ABCD is a quadrilateral.

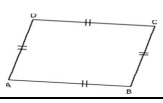
2. Parts of a quadrilateral

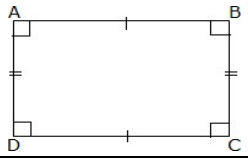
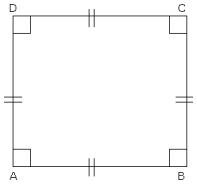
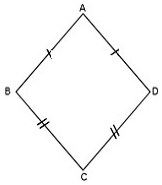
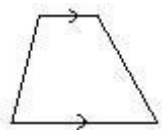
- A quadrilateral has four sides, four angles and four vertices.
- Two sides of a quadrilateral having no common end point are called its **opposite sides**.
- Two sides of a quadrilateral having a common end point are called its **adjacent sides**.
- Two angles of a quadrilateral having common arm are called its **adjacent angles**.
- Two angles of a quadrilateral not having a common arm are called its **opposite angles**.
- A **diagonal** is a line segment obtained on joining the opposite vertices.

3. Angle sum property of a quadrilateral

Sum of all the angles of a quadrilateral is 360^{o}. This is known as the **angle sum property of a quadrilateral**.

4. Types of quadrilaterals and their properties:

Name of a quadrilateral	Properties
Parallelogram: A quadrilateral with each pair of opposite sides parallel. 	i. Opposite sides are equal. ii. Opposite angles are equal. iii. Diagonals bisect one another.
Rhombus: A parallelogram with sides of equal length. 	i. All properties of a parallelogram. ii. Diagonals are perpendicular to each other.

Rectangle: A parallelogram with all angles right angle. 	i. All the properties of a parallelogram. ii. Each of the angles is a right angle. iii. Diagonals are equal.
Square: A rectangle with sides of equal length. 	All the properties of a parallelogram, a rhombus and a rectangle.
Kite: A quadrilateral with exactly two pairs of equal consecutive sides. 	i. The diagonals are perpendicular to one another. ii. One of the diagonals bisects the other. iii. If ABCD is a kite, then $\angle B = \angle D$ but $\angle A \neq \angle C$.
Trapezium: A quadrilateral with one pair of opposite sides parallel is called trapezium. 	i. One pair of opposite sides parallel.

5. Important facts about quadrilaterals

- If the non-parallel sides of trapezium are equal, it is known as **isosceles trapezium**.
- Square, rectangle and rhombus are all parallelograms.
- Kite and trapezium are not parallelograms.
- A square is a rectangle.
- A square is a rhombus.
- A parallelogram is a trapezium.

6. **Properties of a parallelogram**:

i. The opposite sides of a parallelogram are parallel.
ii. A diagonal of a parallelogram divides it in two congruent triangles.

iii. The opposite sides of a parallelogram are equal.

iv. The opposite angles of a parallelogram are equal.
v. The consecutive angles (conjoined angles) of a parallelogram are supplementary.
vi. The diagonals of a parallelogram bisect each other.
vii. Bisectors of the angles form a rectangle.

7. **A quadrilateral is a parallelogram if**:
   i. each pair of opposite sides of a quadrilateral is equal, or
   ii. each pair of opposite angles is equal, or
   iii. the diagonals of a quadrilateral bisect other, or
   iv. each pair of opposite sides is equal and parallel.

8. Mid-Point Theorem
The line segment joining the mid-points of any two sides of a triangle is parallel to the third side and equal to half of it.

9. Converse of mid-point theorem
The line drawn through the mid-point of one side of a triangle, parallel to another side, bisects the third side.

10. Formation of a new quadrilateral using the given data
- If the diagonals of a parallelogram are equal, then it is a rectangle.
- If the diagonals of a quadrilateral bisect each other at right angles, then it is a rhombus.
- If the diagonals of a quadrilateral are equal and bisect each other at right angles, then it is a square.

11. If there are three or more parallel lines and the intercepts made by them on a transversal are equal, then the corresponding intercepts on any other transversal are also equal.