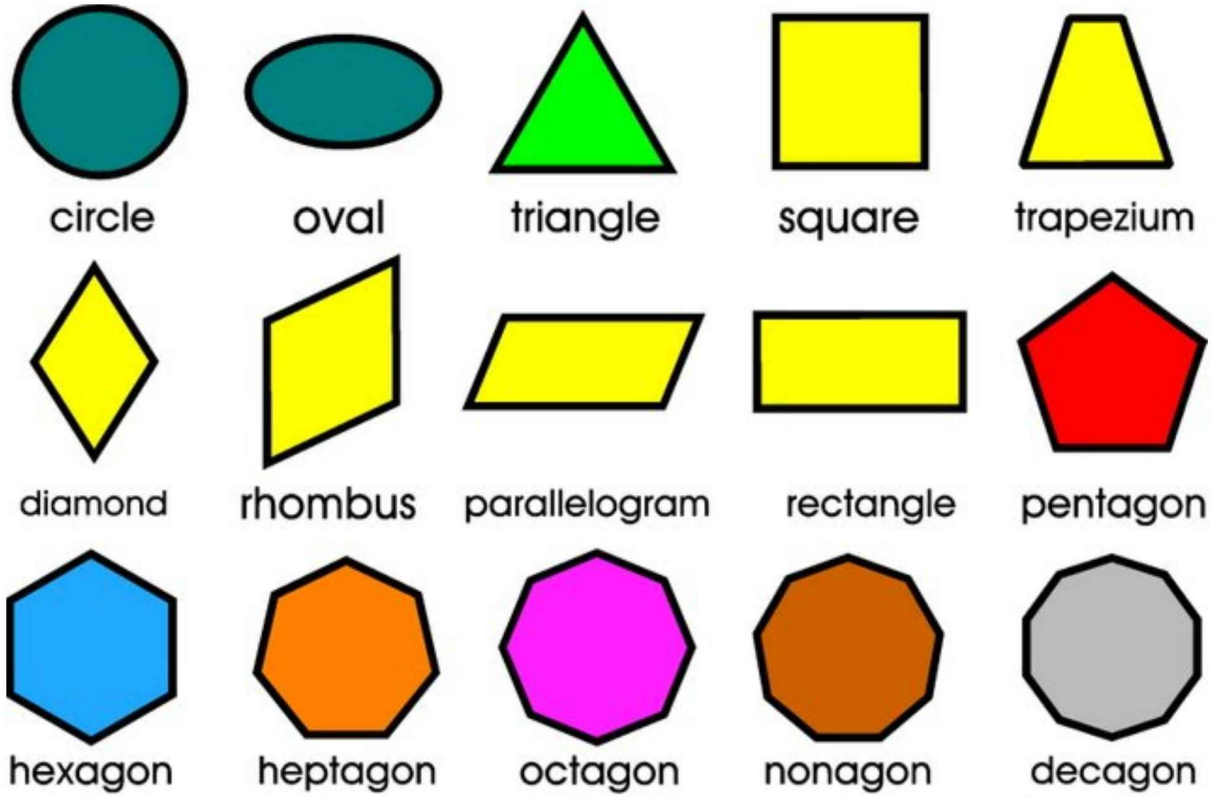
Tender Heart High School,Sector 33B, Chd.

Class : 9th
Subject : Mathematics

Date : 12.8.2024
Teacher : Ms. Reena

Chapter– 11 Quadrilaterals



What is a rectilinear figure ?

It is a plane figure bounded by line segments. Rectilinear means along a straight line or in a straight line

Students recall that polygon is a simple closed figure made up of only line segments. The end points where line segments meet are called 'vertices' of the polygon. The line segments which make the polygon are called 'sides' of the polygon.

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We can classify polygons according to the number of sides or vertices.

The simple polygon we know is a triangle. A triangle has three sides and thus is a three-sided polygon.

A four-sided polygon is called a quadrilateral.

A five-sided polygon is called a pentagon.

In this manner, we can obtain a six-sided polygon called a hexagon, a seven-sided polygon called a heptagon, and so on.

If we have an n-sided polygon it is called an "n-gon."

So, polygon is a closed rectilinear figure.

Now students, let us discuss about a four-sided polygon that is quadrilaterals.

What are Quadrilaterals ?

Quadrilaterals means "four sides"

quad means four, lateral means side.

So, a plane closed figure formed by four line segments is called quadrilateral.

There are many types of quadrilaterals. that is Trapezium, Parallelogram, Squares, Rectangle, Rhombus and kite.

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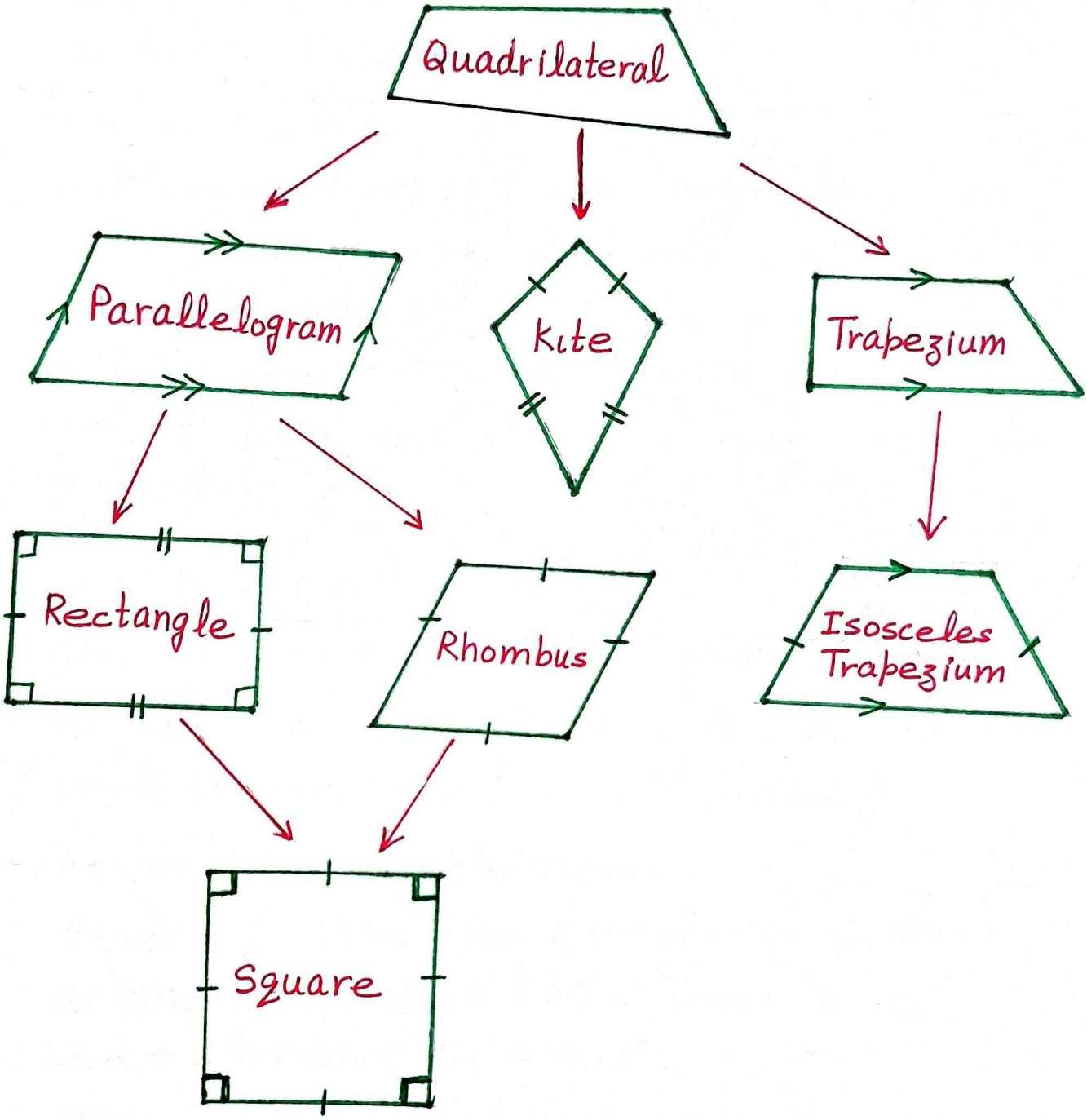
Quadrilateral Flow chart



1) Every Square is a Rectangle as well as a Rhombus.
2) Every Rectangle or a Rhombus is a Parallelogram.
3) Every Parallelogram is a Trapezium.
4) Every Trapezium is a Quadrilateral.

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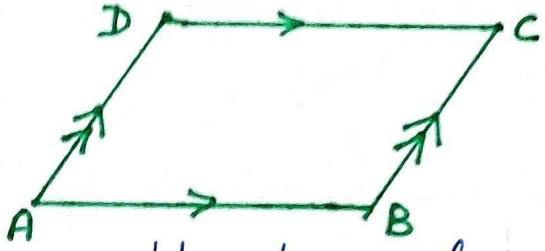
Theorems on Parallelograms :-

Theorem 1 :- In a parallelogram both pairs of opposite sides are equal.

If ABCD is a parallelogram, then $AB = CD$ and $AD = BC$



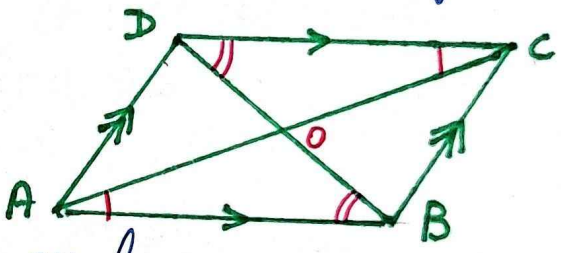
Theorem 2 :- In a parallelogram, opposite angles are equal in both pairs.

that is $\angle A = \angle C$ and $\angle B = \angle D$

Theorem 3 :- The diagonals of a parallelogram bisect each other and bisect the parallelogram.

that is $AO = CO$ and $BO = DO$

and $\Delta ABD \cong \Delta CDB$



So, in a parallelogram,

(i) the opposite sides are equal

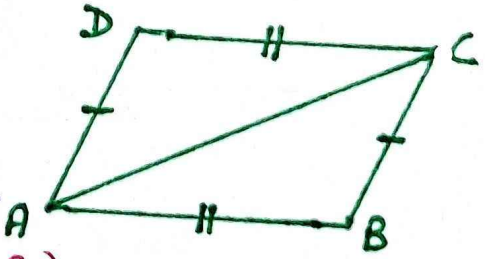
(ii) the opposite angles are equal

(iii) each diagonal bisects the parallelogram.

Theorem 4 (Converse of Theorem 1) :-

A quadrilateral is a parallelogram, if the side in both the pairs of its opposite sides are of equal lengths.

that is if $AB = CD$ and $BC = AD$, then ABCD is a parallelogram.



Theorem 5 (converse of Theorem 2) :-

A quadrilateral is a parallelogram if its opposite angles in each pair are equal.

that is $\angle A = \angle C$ and $\angle B = \angle D$

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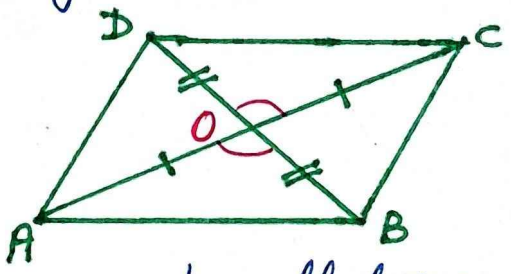
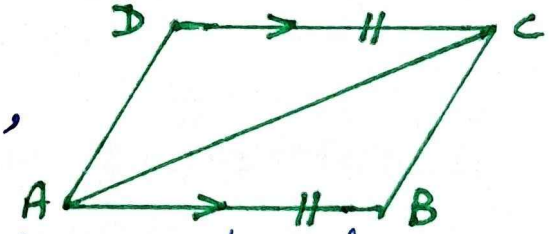
Theorem 6 (Converse of Theorem 3) :-
A quadrilateral is a parallelogram if its diagonals bisect each other.
that is if AO = CO and BO = DO,
then, ABCD is a parallelogram.



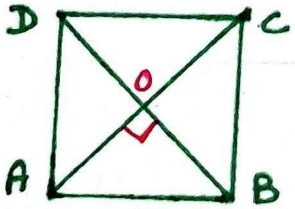
Theorem 7 :- A quadrilateral is a parallelogram if its opposite sides in a pair are parallel and of equal lengths.
that is if AB = DC and AB || DC,
then ABCD is a parallelogram



Theorem 8 :- The diagonals of a rectangle are of equal lengths
AC = BD

Theorem 9 :- The diagonals of a rhombus are perpendicular to each other.
that is $\angle AOB = \angle BOC = \angle COD = \angle DOA$

Theorem 10 :- The diagonals of a square are equal and perpendicular to each other.
that is AC = BD and
AC ⊥ BD



Theorem 11 (Converse of Theorem 8.) :-
If two diagonals of a parallelogram are of equal lengths, then it is a rectangle.
that is if AC = BD

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Theorem 12 (converse of Theorem 9)

If the diagonals of a parallelogram are perpendicular, then it is a rhombus.

that is $AC \perp BD$

Theorem 13 (converse of Theorem 10)

If in a parallelogram, the diagonals are equal and perpendicular, then it is a square.

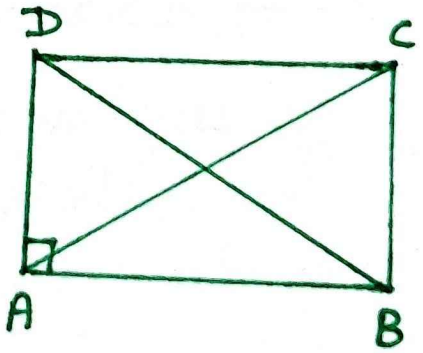
that is $AC = BD$ and $AC \perp BD$.

Now, let us discuss about the properties of rectangle, rhombus and square.

Rectangle

Since every rectangle is a parallelogram, therefore, it has all the properties of a parallelogram. Additional properties of a rectangle are :-

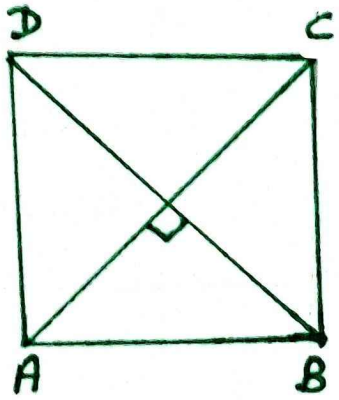
1) All the interior angles of a rectangle are right angles.
$\angle A = \angle B = \angle C = \angle D = 90°$
2) The diagonals of a rectangle are equal. $AC = BD$



Rhombus

Every rhombus is a parallelogram.

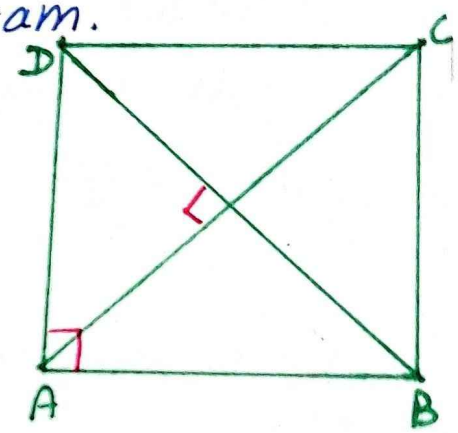
1) All the sides of a rhombus are equal. $AB = BC = CD = DA$
2) The diagonals of a rhombus intersect at right angles. $AC \perp BD$



3) The diagonals bisect the angles of a rhombus. AC bisect ∠A as well as ∠C and diagonal BD bisect ∠B as well as ∠D.

Square

Every square is a parallelogram.



1) All the interior angles of a square are right angles.
$\angle A = \angle B = \angle C = \angle D = 90^\circ$
2) All the sides of a square are equal. $AB = BC = CD = DA$
3) The diagonals of a square are equal. $AC = BD$.
4) The diagonals of a square intersect at right angles. $AC \perp BD$
5) The diagonals bisect the angles of a square. Diagonal AC bisect ∠A as well as ∠C and diagonal BD bisect ∠B as well as ∠D

So, a square is a rectangle as well as a rhombus, so it has all the properties of a rectangle as well as that of a rhombus.

I hope students now the concept of parallelogram is clear to everyone. It is important to understand the properties of square, rectangle and rhombus and how they are different from each other.