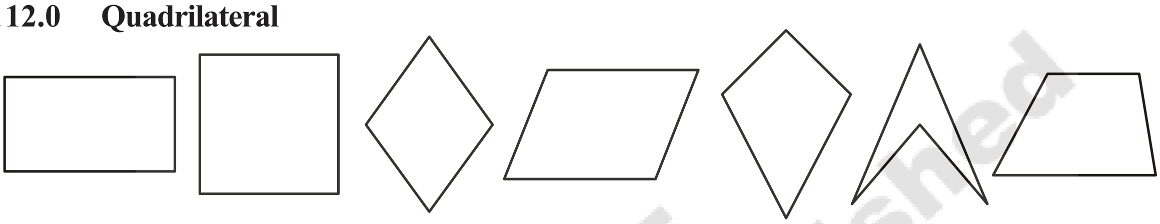
QUADRILATERALS

12

In Class VI, we have been introduced to quadrilaterals. In this unit you will learn about the different types of quadrilaterals and their properties in detail.

12.0 Quadrilateral

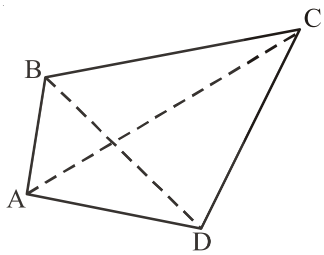


What is common among all these pictures?

(Hints: Number of sides, angles, vertices. Is it an open or closed figure?)

Thus, a quadrilateral is a closed figure with four sides, four angles and four vertices.

Quadrilateral ABCD has



(i) Four sides, namely $\overline{AB}, \overline{BC}, \overline{CD}$ and $\overline{DA}$

(ii) Four vertices, namely A, B, C and D.

(iii) Four angles, namely ∠ABC, ∠BCD, ∠CDA and ∠DAC.

(iv) The line segments joining the opposite vertices of a quadrilateral are called the diagonals of the quadrilateral. $\overline{AC}$ and $\overline{BD}$ are the diagonals of quadrilateral ABCD.

(v) The two sides of a quadrilateral which have a common vertex are called the 'adjacent sides' of the quadrilateral. In quadrilateral ABCD, $\overline{AB}$ is adjacent to $\overline{BC}$ and B is their common vertex.

(vi) The two angles of a quadrilateral having a common side are called the pair of 'adjacent angles' of the quadrilateral. Thus, ∠ABC and ∠BCD are a pair of adjacent angles and $\overline{BC}$ is the common side.

Do This :

1. Find the other adjacent sides and common vertices.

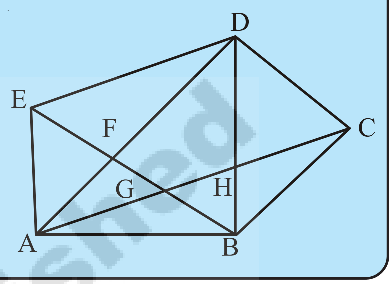
2. Find the other pairs of adjacent angles and sides.

(vii) The two sides of a quadrilateral, which do not have a common vertex, are called a pair of 'opposite sides' of the quadrilateral. Thus $\overline{AB}$, $\overline{CD}$ and $\overline{AD}$, $\overline{BC}$ are the two pairs of 'opposite sides' of the quadrilateral.

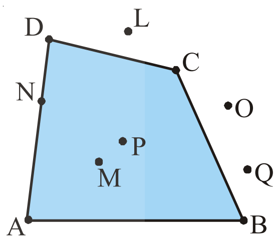
(viii) The two angles of a quadrilateral which do not have a common side are known as a pair of 'opposite angles' of the quadrilateral. Thus $\angle BAD$, $\angle DCB$ and $\angle ADC$, $\angle CBA$ are the two pairs of opposite angles of the quadrilateral.

Try This

How many different quadrilaterals can be obtained from the adjacent figure? Name them.



12.1 Interior-Exterior of a quadrilateral



In quadrilateral ABCD which points lie inside the quadrilateral?

Which points lie outside the quadrilateral?

Which points lie on the quadrilateral?

Points P and M lie in the interior of the quadrilateral. Points L, O and Q lie in the exterior of the quadrilateral. Points N, A, B, C and D lie on the quadrilateral.

Mark as many points as you can in the interior of the quadrilateral.

Mark as many points as you can in the exterior of the quadrilateral.

How many points, do you think will be there in the interior of the quadrilateral?

12.2 Convex and Concave quadrilateral

Mark any two points L and M in the interior of quadrilateral ABCD and join them with a line segment.

Does the line segment or a part of it joining these points lie in the exterior of the quadrilateral? Can you find any two points in the interior of the quadrilateral ABCD for which the line segment joining them falls in the exterior of the quadrilateral?

You will see that this is not possible.

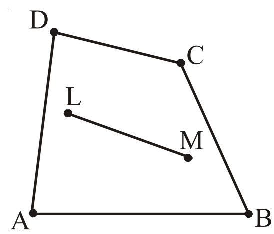
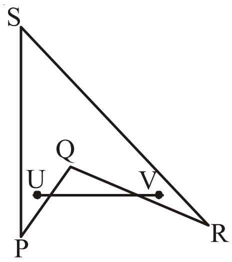


Figure1

Now let us do similar work in quadrilateral PQRS.

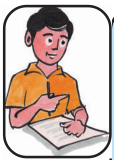
Mark any two points U and V in the interior of quadrilateral PQRS and join them. Does the line segment joining these two points fall in the exterior of the quadrilateral? Can you make more line segments like these in quadrilateral PQRS.



Can you also make line segments, joining two points, which lie in the interior of the quadrilateral. You will find that this is possible too.

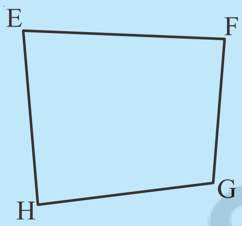
Quadrilateral ABCD is said to be a convex quadrilateral if all line segments joining points in the interior of the quadrilateral also lie in interior of the quadrilateral.

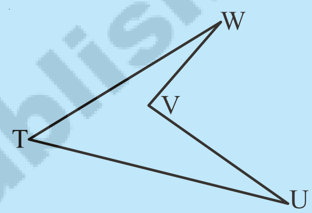
Quadrilateral PQRS is said to be a concave quadrilateral if all line segment joining points in the interior of the quadrilateral do not necessarily lie in the interior of the quadrilateral.



Try This

1.





(i) Is quadrilateral EFGH a convex quadrilateral?

(ii) Is quadrilateral TUVW a concave quadrilateral?

(iii) Draw both the diagonals for quadrilateral EFGH. Do they intersect each other?

(iv) Draw both the diagonals for quadrilateral TUVW. Do they intersect each other?

You will find that the digonals of a convex quadrilateral intersect each other in the interior of the quadrilateral and the diagonals of a concave quadrialteral intersect each other in the exterior of the quadrilateral.

12.3 Angle-sum property of a quadrilateral

Activity 1

Take a piece of cardboard. Draw a quadrilateral ABCD on it. Make a cut of it. Then cut quadrilateral into four pieces (Figure 1) and arrange them as shown in the Figure 2, so that all angles ∠1, ∠2, ∠3, ∠4 meet at a point.

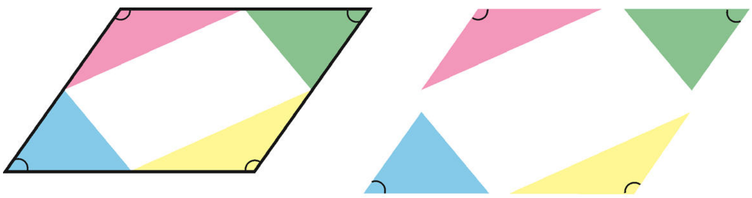


Figure 1

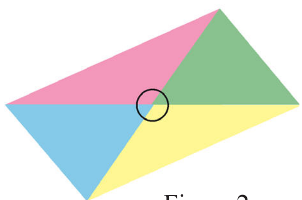


Figure 2

Is the sum of the angles $\angle 1, \angle 2, \angle 3$ and $\angle 4$ equal to 360^o? (sum of angles at a point)

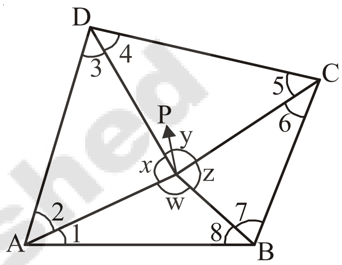
The sum of the four angles of a quadrilateral is 360°.

[Note: We can denote the angles by $\angle 1, \angle 2, \angle 3$, etc., as their respective measures i.e. $m\angle 1$, $m\angle 2$, $m\angle 3$, etc.]

You may arrive at this result in several other ways also.

1. Let P be any point in the interior of quadrilateral ABCD. Join P to vertices A, B, C and D.

   In the figure, consider ΔPAD.



   $m\angle 2 + m\angle 3 = 180° - x$ .... (1)

   Similarly, in ΔPDC, $m\angle 4 + m\angle 5 = 180° - y$ .... (2)

   in ΔPCB, $m\angle 6 + m\angle 7 = 180^o - z$ and .... (3)

   in ΔPBA, $m\angle 8 + m\angle 1 = 180^o - w$. .... (4)

   (angle-sum property of a triangle)

   Adding (1), (2), (3) and (4) we get

   $m\angle 1 + m\angle 2 + m\angle 3 + m\angle 4 + m\angle 5 + m\angle 6 + m\angle 7 + m\angle 8$

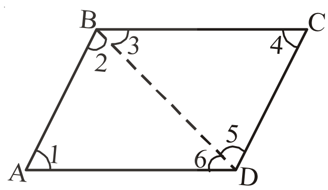
   $= 180° - x + 180° - y + 180° - z + 180° - w$

   $= 720° - (x + y + z + w)$

   $(x + y + z + w = 360^o$; sum of angles at a point)

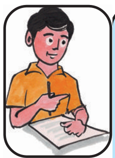
   $= 720° - 360°$ $= 360°$

   Thus, the sum of the angles of the quadrilateral is 360^o.



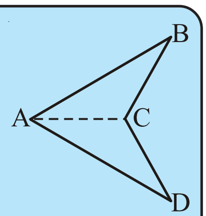
2. Take any quadrilateral, say ABCD. Divide it into two triangles, by drawing a diagonal. You get six angles 1, 2, 3, 4, 5 and 6.

   Using the angle-sum property of a triangle and you can easily find how the sum of the measures of $\angle A$, $\angle B$, $\angle C$ and $\angle D$ amounts to 360°.



Try This

What would happen if the quadrilateral is not convex? Consider quadrilateral ABCD. Split it into two triangles and find the sum of the interior angles. What is the sum of interior angles of a concave quadrilateral?



Example 1 : The three angles of a quadrilateral are 55°, 65° and 105°. What is the fourth angle?

Solution : The sum of the four angles of a quadrilateral is 360°.

The sum of the given three angles $= 55° + 65° + 105° = 225°$

Therefore, the fourth angle $= 360° – 225° = 135°$

Example 2 : In a quadrilateral, two angles are 80° and 120°. The remaining two angles are equal. What is the measure of each of these angles?

Solution : The sum of the four angles of the quadrilateral is 360°.

Sum of the given two angles $= 80° + 120° = 200°$

Therefore, the sum of the remaining two angles $= 360° – 200° = 160°$

Both these angles are equal.

Therefore, each angle $= 160° \div 2 = 80°$

Example 3 : The angles of a quadrilateral are $x°$, $(x – 10)°$, $(x + 30)°$ and $2x°$. Find the angles.

Solution: The sum of the four angles of a quadrilateral $= 360°$

Therefore, $x + (x – 10) + (x + 30) + 2x = 360°$

Solving, $5x + 20 = 360°$

$x = 68°$

Thus, the four angles are $= 68°$; $(68–10)°$; $(68+30)°$; $(2×68)°$

$= 68°, 58°, 98°$ and $136°$.

Example 4 : The angles of a quadrilateral are in the ratio 3 : 4 : 5 : 6. Find the angles.

Solution : The sum of four angles of a quadrilateral = 360°

The ratio of the angles is 3 : 4 : 5 : 6

Thus, the angles are $3x$, $4x$, $5x$ and $6x$.

$$3x + 4x + 5x + 6x = 360$$

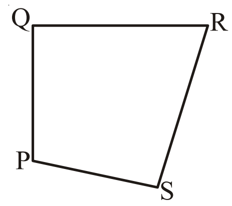
$$18x = 360$$

$$x = \frac{360}{18} = 20$$

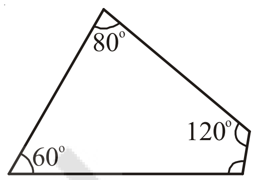
Thus, the angles are $= 3 \times 20; 4 \times 20; 5 \times 20; 6 \times 20$

$= 60°, 80°, 100°$ and $120°$

Exercise - 1



1. In quadrilateral PQRS
   (i) Name the sides, angles, vertices and diagonals.
   (ii) Also name all the pairs of adjacent sides, adjacent angles, opposite sides and opposite angles.



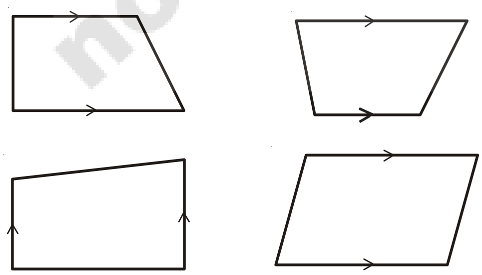
2. The three angles of a quadrilateral are 60°, 80° and 120°. Find the fourth angle?
3. The angles of a quadrilateral are in the ratio 2 : 3 : 4 : 6. Find the measure of each of the four angles.
4. The four angles of a quadrilateral are equal. Draw this quadrilateral in your notebook. Find each of them.
5. In a quadrilateral, the angles are $x°$, $(x + 10)°$, $(x + 20)°$, $(x + 30)°$. Find the angles.
6. The angles of a quadrilateral cannot be in the ratio 1 : 2 : 3 : 6. Why? Give reasons.
   (Hint: Try to draw a rough diagram of this quadrilateral)

12.4 Types of quadrilaterals

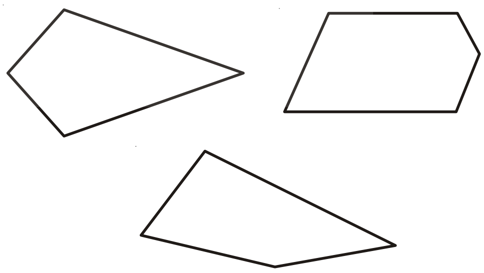
Based on the nature of the sides and angles, quadrilaterals have different names.

12.4.1 Trapezium

Trapezium is a quadrilateral with one pair of parallel sides.



These are trapeziums



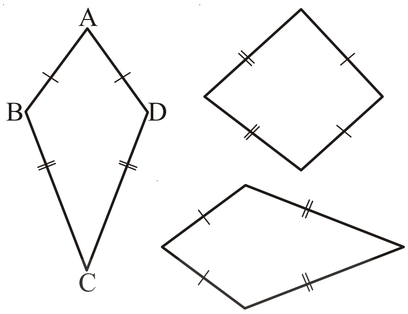
These are not trapeziums

(Note: The arrow marks indicate parallel lines).

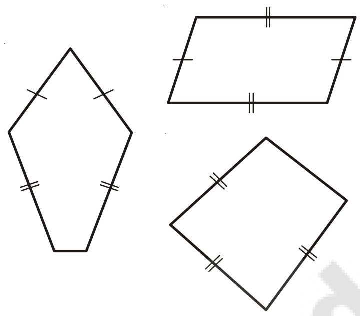
Why the second set of figures not trapeziums?

12.4.2 Kite

A Kite is a special type of quadrilateral. The sides with the same markings in each figure are equal in length. For example AB = AD and BC = CD.



These are kites



These are not kites

Why the second set of figures arenot kites?

Observe that:

(i) **A kite has 4 sides (It is a convex quadrilateral).**

(ii) **There are exactly two distinct, consecutive pairs of sides of equal length.**

Activity 2

Take a thick sheet of paper. Fold the paper at the centre. Draw two line segments of different lengths as shown in Figure 1. Cut along the line segments and open up the piece of paper as shown in Figure 2. You have the shape of a kite.

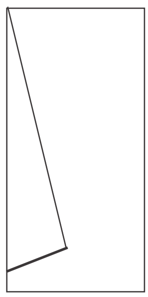


Figure1

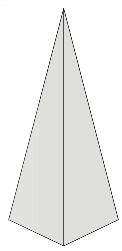


Figure2

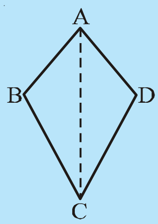
Does the kite have line symmetry?

Fold both the diagonals of the kite. Use the set-square to check if they cut at right angles.

Are the diagonals of the kite equal in length? Verify (by paper-folding or measurement) if the diagonals bisect each other.

Try This

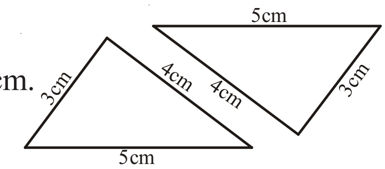
Prove that in a kite ABCD, ΔABC and ΔADC are congruent.

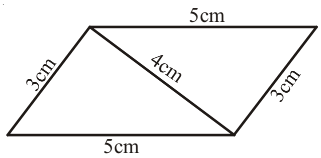


12.4.3 Parallelogram

Activity 3

Take two identical cut-outs of a triangle of sides 3 cm, 4 cm, 5 cm. Arrange them as shown in the figure given below:





You get a parallelogram. Which are the parallel sides here? Are the parallel sides equal? You can get two more parallelograms using the same set of triangles. Find them out.

A parallelogram is a quadrilateral with two pairs of opposite sides are parallel.

Activity 4

Take a ruler. Place it on a paper and draw two lines along its two sides as shown in Figure1. Then place the ruler over the lines as shown in Figure2 and draw two more lines along its edges again.

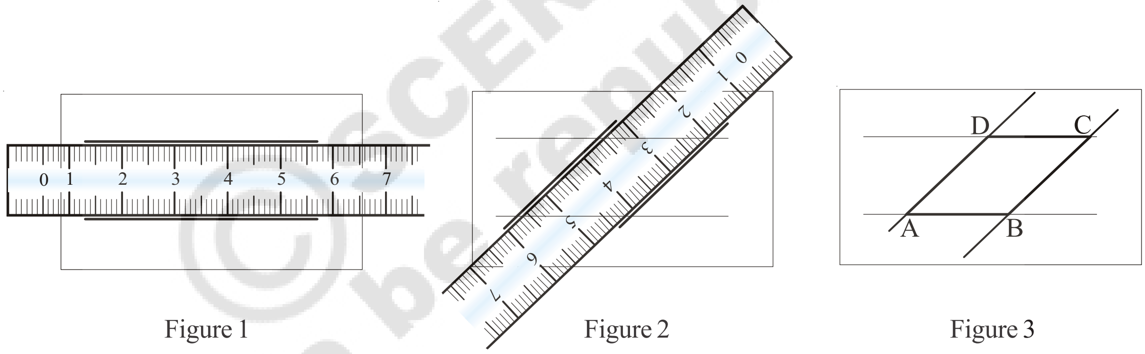


Figure 1 Figure 2 Figure 3

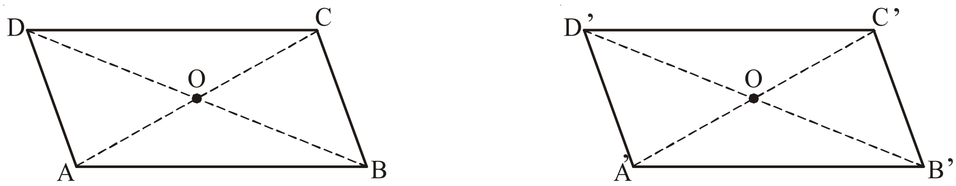
These four lines enclose a quadrilateral which is made up of two pairs of parallel lines. It is a parallelogram.

12.4.3(a) Properties of a parallelogram

Sides of parallelogram

Activity 5

Take cut-outs of two identical parallelograms, say ABCD and A'B'C'D'.



Here $\overline{AB}$ is same as $\overline{A'B'}$ except for the name. Similarly, the other corresponding sides are equal too. Place $\overline{A'B'}$ over $\overline{DC}$. Do they coincide? Are the lengths $\overline{A'B'}$ and $\overline{DC}$ equal?

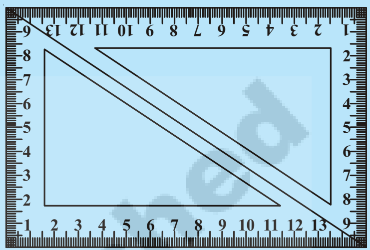
Similarly examine the lengths $\overline{AD}$ and $\overline{B'C'}$. What do you find?

You will find that the sides are equal in both cases. Thus, **the opposite sides of a parallelogram are of equal length.**

You will also find the same results by measuring the side of the parallelogram with a scale.

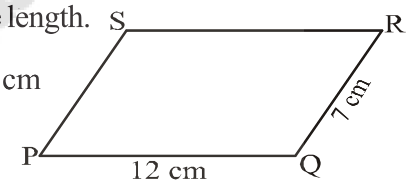
Try This

Take two identical set squares with angles 30° – 60° – 90° and place them adjacently as shown in the adjacent figure. Does this help you to verify the above property? Can we say every rectangle is a parallelogram?



Example 5 : Find the perimeter of the parallelogram PQRS.

Solution : In a parallelogram, the opposite sides have same length.



According to the question, PQ= SR = 12 cm and QR = PS = 7 cm

Thus, Perimeter = PQ + QR + RS + SP

= 12 cm + 7 cm + 12 cm + 7 cm = 38 cm

Angles of a parallelogram

Activity 6

Let ABCD be a parallelogram. Copy it on a tracing sheet. Name this copy as A'B'C'D'. Place A'B'C'D' on ABCD as shown in Figure 1. Pin them together at the point where the diagonals meet. Rotate the transparent sheet by 90° as shown in Figure 2. Then rotate the parallelogram again by 90° in the same direction. You will find that the parallelograms coincide as shown in Figure 3. You now find A' lying exactly on C and C' lying on A. Similarly B' lies on D and D' lies on B as shown in Figure 3.

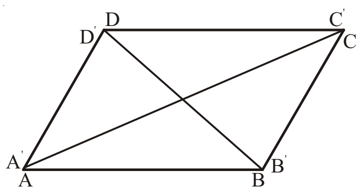


Figure 1

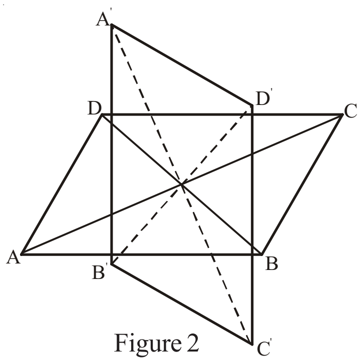


Figure 2

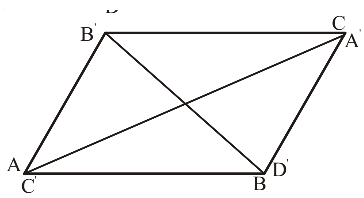


Figure 3

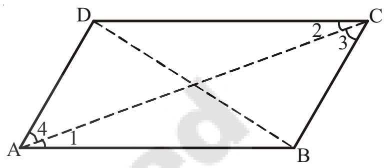
Does this tell you anything about the measures of the angles A and C? Examine the same for angles B and D. State your findings.

You will conclude that the opposite angles of a parallelogram are of equal measure.

Try This

Take two identical $30° - 60° - 90°$ set squares and form a parallelogram as before. Does the figure obtained help you confirm the above property?

You can justify this idea through logical arguments-



If $\overline{AC}$ and $\overline{BD}$ are the diagonals of the parallelogram ABCD you find that $\angle 1 = \angle 2$ and $\angle 3 = \angle 4$ (alternate angles property)

ΔABC and ΔCDA are congruent $\Delta ABC \cong \Delta CDA$ (ASA congruency).

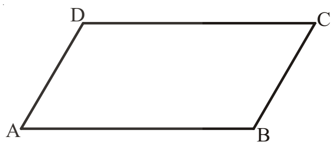
Therefore, $m\angle B = m\ \angle D$ (c.p.c.t.).

Similarly, $\Delta ABD \cong \Delta CDB$, therefore, $m\ \angle A = m\ \angle C$. (c.p.c.t.).

Thus, the opposite angles of a parallelogram are of equal measure.

We now turn our attention to adjacent angles of a parallelogram.

In parallelogram ABCD, $\overline{DC} \parallel \overline{AB}$ and $\overline{DA}$ is the transversal.



Therefore, $\angle A$ and $\angle D$ are the interior angles on the same side of the transversal.thus are supplementary.

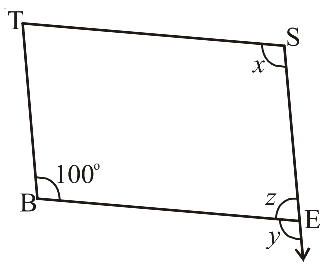
$\angle A$ and $\angle B$ are also supplementary. Can you say 'why'?

$\overline{AD} \parallel \overline{BC}$ and $\overline{BA}$ is a transversal, making $\angle A$ and $\angle B$ interior angles.

Do This

Identify two more pairs of supplementary angles from the parallelogram ABCD given above.

Example 6 : BEST is a parallelogram. Find the values x, y and z.



Solution : $\angle S$ is opposite to $\angle B$.

So, $x = 100°$ (opposite angles property)

$y = 100°$ (corresponding angles)

$z = 80°$ (since $\angle y, \angle z$ is a linear pair)

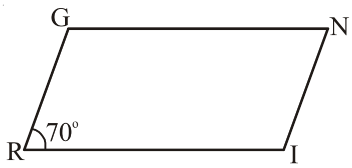
The adjacent angles in a parallelogram are supplementary. You have observed the same result in the previous example.

Example 7 : In parallelogram RING if m $\angle R = 70°$, find all the other angles.

Solution : According to the question, $m\angle R = 70°$

Then $m\angle N = 70°$

(opposite angles of a parallelogram)

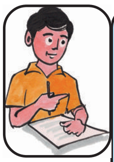


Since $\angle R$ and $\angle I$ are supplementary angles,

$m\angle I = 180° - 70° = 110°$

Also, $m\angle G = 110°$ since $\angle G$ and $\angle I$ are opposite angles of a parallelogram.

Thus, $m\angle R = m\angle N = 70°$ and $m\angle I = m\angle G = 110°$



Try this

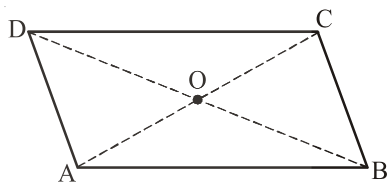
For the above example, can you find m $\angle I$ and m $\angle G$ by any other method?

Hint : angle-sum property of a quadrilateral

12.4.3 (b) Diagonals of parallelogarm

Activity 7

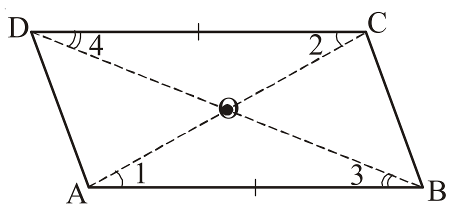
Take a cut-out of a parallelogram, say, ABCD. Let its diagonals $\overline{AC}$ and $\overline{DB}$ meet at O.



Find the mid-point of $\overline{AC}$ by folding and placing C on A. Is the mid-point same as O?

Find the mid-point of $\overline{DB}$ by folding and placing D on B. Is the mid-point same as O?

Does this show that diagonal $\overline{DB}$ bisects the diagonal AC at the point O? Discuss it with your friends. Repeat the activity to find where the mid point of DB could lie.



The diagonals of a parallelogram bisect each other

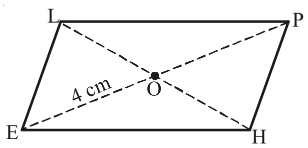
It is not very difficult to justify this property using ASA congruency:

$\Delta AOB \cong COD$ (How is ASA used here?)

This gives AO = CO and BO = DO

Example 8 : HELP is a parallelogram. Given that OE = 4 cm, where O is the point of intersection of the diagonals and HL is 5 cm more than PE? Find OH.

Solution : If OE = 4 cm then OP also is 4 cm (Why?)



So PE = 8 cm (Why?)

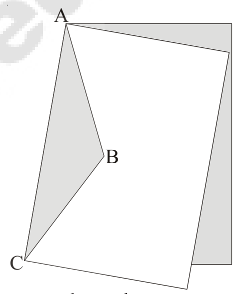
HL is 5 cm more than PE

Therefore, HL = 8 + 5 = 13 cm

Thus, $OH = \frac{1}{2} \times 13 = 6.5$ cms

12.4.4 Rhombus

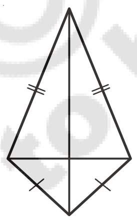
Recall the paper-cut kite you made earlier. When you cut along ABC and opened up, you got a kite. Here lengths AB and BC were different. If you draw AB = BC, then the kite you obtain is called a rhombus.

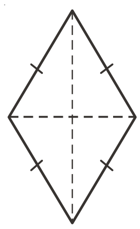


Rhombus-cut

Note that all the sides of rhombus are of same length; this is not the case with the kite.

Since the opposite sides of a rhombus are parallel, it is also parallelogram. So, a rhombus has all the properties of a parallelogram and also that of a kite. Try to list them out. You can then verify your list with the check list at the end of the chapter.


Kite


Rhombus

The diagonals of a rhombus are perpendicular bisectors of one another

Activity 8

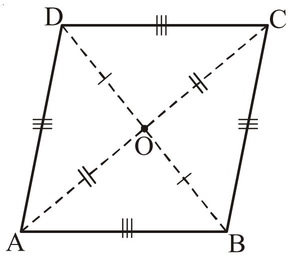
Take a copy of a rhombus. By paper-folding verify if the point of intersection is the mid-point of each diagonal. You may also check if they intersect at right angles, using the corner of a set-square.

Now let us justify this property using logical steps.

ABCD is a rhombus. It is a parallelogram too, so diagonals bisect each other.

Therefore, OA = OC and OB = OD.

We now have to show that m∠AOD = m∠COD = 90°.



It can be seen that by SSS congruency criterion.

ΔAOD ≅ ΔCOD

Therefore, m ∠AOD = m∠COD

Since ∠AOD and ∠COD are a linear pair,

m ∠AOD = m ∠COD = 90°

We conclude, the diagonals of a rhombus are perpendicular bisectors of each other.

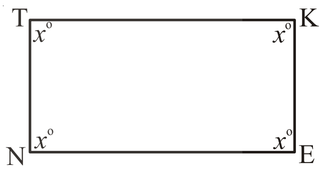
12.4.5 Rectangle

A rectangle is a parallelogram with equal angles.

What is the full meaning of this definition? Discuss with your friends.

If the rectangle is to be equiangular, what could be the measure of each angle?

Let the measure of each angle be x°.



Then $4x° = 360°$ (Why)?

Therefore, $x° = 90°$

Thus, each angle of a rectangle is a right angle.

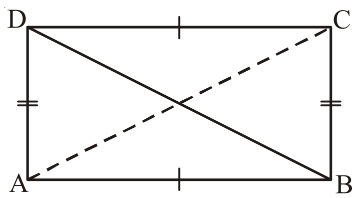
So, a rectangle is a parallelogram in which every angle is a right angle.

Being a parallelogram, the rectangle has opposite sides of equal length and its diagonals bisect each other.

In a parallelogram, the diagonals can be of different lengths. (Check this); but surprisingly the rectangle (being a special case) has diagonals of equal length.

This is easy to justify:

If ABCD is a rectangle,



ΔABC ≅ ΔABD

This is because AB = AB (Common)

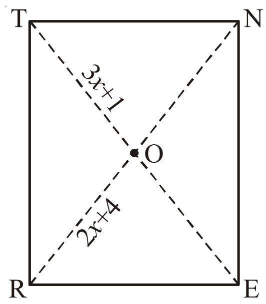
BC = AD (Why?)

m ∠A = m ∠B = 90° (Why?)

Thus, by SAS criterion ΔABC ≅ ΔABD and AC = BD (c.p.c.t.)

Thus, in a rectangle the diagonals are of equal length.

Example 9 : RENT is a rectangle. Its diagonals intersect at O. Find x, if OR = $2x + 4$ and OT = $3x + 1$.



Solution : OT is half of the diagonal TE and OR is half of the diagonal RN .

Diagonals are equal here. (Why?)

So, their halves are also equal.

Therefore $3x + 1 = 2x + 4$

or $x = 3$

12.4.6 Square

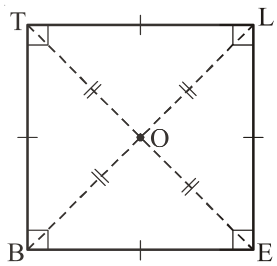
A square is a rectangle with equal adjacent sides.

This means a square has all the properties of a rectangle with an additional property that all the sides have equal length.

The square, like the rectangle, has diagonals of equal length.

In a rectangle, there is no requirement for the diagonals to be perpendicular to one another (Check this). However, this is not true for a square.

Let us justify this-



BELT is a square, therefore, BE = EL = LT = TB

Now, let us consider ΔBOE and ΔLOE

OB=OL (why?)

OE is common

Thus, by SSS congruency ΔBOE $\cong$ LOE

So $\angle BOE = \angle LOE$

but $\angle BOE + \angle LOE = 180^\circ$ (why?)

$$\angle BOE = \angle LOE = \frac{180}{2} = 90^\circ$$

Thus, the diagonals of a square are perpendicular bisectors of each other.

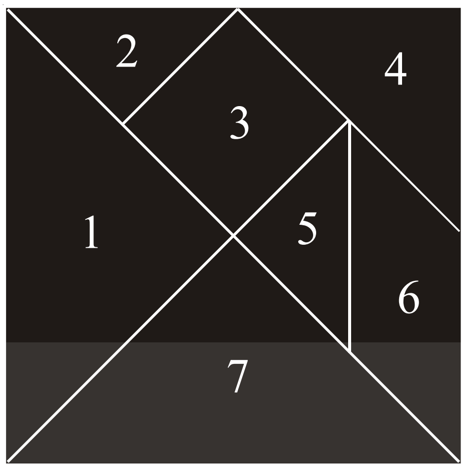
In a square the diagonals.

(i) **bisect one another** **(square being a parallelogram)**

(ii) **are of equal length** **(square being a rectangle) and**

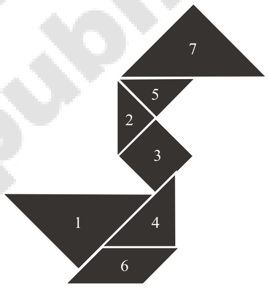
(iii) **are perpendicular to one another.**

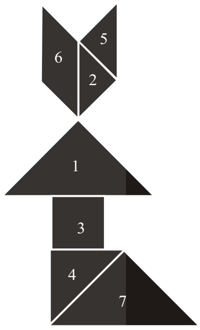
12.5 Making figures with a tangram.

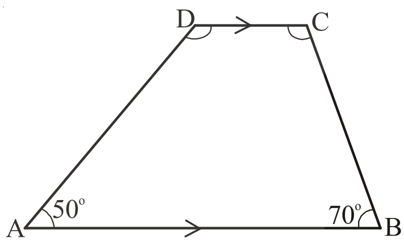


Use all the pieces of tangarm to form a trapezium, a parallelogram, a rectangle and a square.

Also make as many different kinds of figures as you can by using all the pieces. Two examples have been given for you.







Example 10 : In trapezium ABCD, $\overline{AB}$ is parallel to $\overline{CD}$. If $\angle A = 50°$, $\angle B = 70°$. Find $\angle C$ and $\angle D$.

Solution : Since $\overline{AB}$ is parallel to $\overline{CD}$

$\angle A + \angle D = 180°$ (interior angles on the same side of the transversal)

So $\angle D = 180° - 50° = 130°$

Similarly, $\angle B + \angle C = 180°$

So $\angle C = 180° - 70° = 110°$

Example 11 : The measures of two adjacent angles of a parallelogram are in the ratio 3 : 2. Find the angles of the parallelogram.

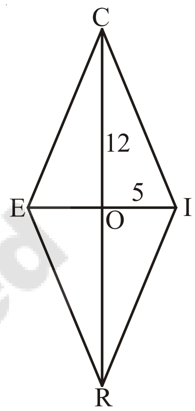
Solution : The adjacent angles of a parallelogram are supplementary.

i.e. their sum = 180°

Ratio of adjacent angles = 3:2

So, each of the angles is $180 \times \frac{3}{5} = 108^\circ$ and

$180 \times \frac{2}{5} = 72^\circ$



Example 12 : RICE is a rhombus. Find OE and OR. Justify your findings.

Solution : Diagonals of a rhombus bisect each other

i.e., OE = OI and OR = OC

Therefore, OE = 5 and OR = 12

Exercise - 2

1. State whether true or false-

   (i) All rectangles are squares ( )

   (ii) All rhombuses are parallelogram ( )

   (iii) All squares are rhombuses and also rectangles ( )

   (iv) All squares are not parallelograms ( )

   (v) All kites are rhombuses ( )

   (vi) All rhombuses are kites ( )

   (vii) All parallelograms are trapeziums ( )

   (viii) All squares are trapeziums ( )

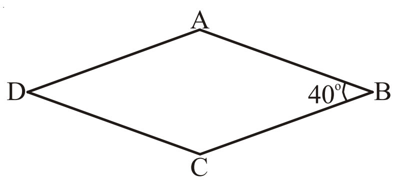
2. Explain how a square is a-

   (i) quadrilateral (ii) parallelogram

   (iii) rhombus (iv) rectangle.

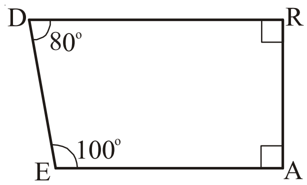
3. In a rhombus ABCD, $\angle CBA = 40^\circ$.

   Find the other angles.

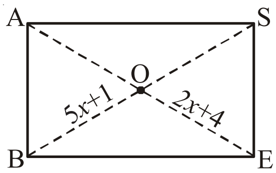


4. The adjacent angels of a parallelogram are $x°$ and $(2x + 30)°$. Find all the angles of the parallelogram.

5. Explain how DEAR is a trapezium. Which of its two sides are parallel?



6. BASE is a rectangle. Its diagonals intersect at O. Find x, if $OB = 5x+1$ and $OE = 2x + 4$.



7. Is quadrilateral ABCD a parallelogram, if $\angle A = 70°$ and $\angle C = 65°$? Give reason.

8. Two adjacent sides of a parallelogram are in the ratio 5:3 the perimeter of the parallelogram is 48cm. Find the length of each of its sides.

9. The diagonals of the quadrilateral are perpendicular to each other. Is such a quadrilateral always a rhombus? Draw a rough figure to justify your answer.

10. ABCD is a trapezium in which $\overline{AB} \parallel \overline{DC}$. If $\angle A = \angle B = 30°$, what are the measures of the other two angles?

11. Fill in the blanks.

(i) A parallelogram in which two adjacent sides are equal is a ____________.

(ii) A parallelogram in which one angle is 90° and two adjacent sides are equal is a ____________.

(iii) In trapezium ABCD, $\overline{AB} \parallel \overline{DC}$. If $\angle D = x°$ then $\angle A =$ __________.

(iv) Every diagonal in a parallelogram divides it in to ________ triangles.

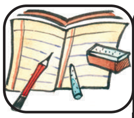
(v) In parallelogram ABCD, its diagonals $\overline{AC}$ and $\overline{BD}$ intersect at O. If AO = 5cm then AC = ________cm.

(vi) In a rhombus ABCD, its diagonals intersect at 'O'. Then $\angle AOB =$ ________ degrees.

(vii) ABCD is a parallelogram then $\angle A - \angle C =$ ________ degrees.

(viii) In a rectangle ABCD, the diagonal AC = 10cm then the diagonal BD = _______cm.

(ix) In a square ABCD, the diagonal $\overline{AC}$ is drawn. Then $\angle BAC =$ __________ degrees.



Looking back

1. A simple closed figure bounded by four line segments is called a quadrilateral.
2. Every quadrilateral divides a plane into three parts interior, exterior and the quadrilateral.
3. Every quadrilateral has a pair of diagonals.
4. If the diagonals lie in the interior of the quadrilateral it is called convex quadrilateral. If any one of the diagonals is not in the interior of the quadrilateral it is called a concave Quadrilateral.
5. The sum of interior angles of a quadrilateral is equal to 360°.
6. Properties of Quadrilateral

Quadrilateral	Properties
Parallelogram : A quadrilateral with both pair, of opposite sides parallel	(1) Opposite sides are equal. (2) Opposite angles are equal. (3) Diagonals bisect one another.
Rhombus : A parallelogram with all sides of equal length.	(1) All the properties of a parallelogram. (2) Diagonals are perpendicular to each other.
Rectangle : A parallelogram with all right angles.	(1) All the properties of a parallelogram. (2) Each of the angles is a right angle. (3) Diagonals are equal.
Square : A rectangle with sides of equal length.	All the properties of a parallelogram, rhombus and a rectangle
Kite : A quadrilateral with exactly two pairs of equal consecutive sides.	(1) The diagonals are perpendicular to one another. (2) The diagonals are not of equal length. (3) One of the diagonals bisects the other.
Trapezium: A quadrilateral with one pair sides parallel.	1) One pair of opposite sides are parallel

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