CHAPTER – 8
QUADRILATERALS

8.1 INTRODUCTION

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

(I) Since, **'quad'** means **'four'** and **'lateral'** is for **'sides'** therefore **'quadrilateral'** means **'a figure bounded by four sides'.**

(II) Every quadrilateral has :

(A) Four vertices,

(B) Four sides

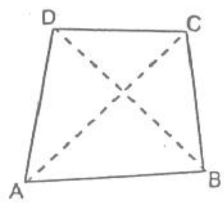
(C) Four angles and

(D) Two diagonals.

(III) A diagonals is a line segment obtained on joining the opposite vertices.

(a) Sum of the Angles of a Quadrilateral :

Consider a quadrilateral ABCD as shown alongside. Join A and C to get the diagonal AC which divides the quadrilateral ABCD into two triangles ABC and ADC.



We know the sum of the angles of each triangle is 180^0(2 right angles).

$\therefore$ In ΔABC ; $\angle CAB + \angle B + \angle BCA = 180^0$ and

In ΔADC ; $\angle DAC + \angle D + \angle DCA = 180^0$

On adding, we get : $(\angle CAB + \angle DAC) + \angle B + \angle D + (\angle BCA + \angle DCA) = 180^0 + 180^0$

$\Rightarrow \angle A + \angle B + \angle D + \angle C = 360^0$

Thus, the sum of the angles of a quadrilateral is 360^0 (4-right angles).

Ex.1 The angles of a quadrilateral are in the ratio 3 : 5 : 9 : 13. Find all the angles of the quadrilateral.

Sol. Given the ratio between the angles of the quadrilateral = 3 : 5 : 9 : 13 and 3 + 5 + 9 + 13 = 30

Since, the sum of the angles of the quadrilateral = 360^0

$\therefore$ First angle of it = $\frac{3}{30} \times 360^0 = 36^0$,

Second angle = $\frac{5}{30} \times 360^0 = 60^0$,

Third angle = $\frac{9}{30} \times 360^0 = 108^0$,

And, Fourth angle = $\frac{13}{30} \times 360^0 = 156^0$

$\therefore$ The angles of quadrilateral are 360^0, 60^0, 108^0 and 156^0.

ALTERNATE SOLUTION :

Let the angles be 3x, 5x, 9x and 13.

$\therefore$ $3x + 5x + 9x + 13x = 360^0$

$\Rightarrow$ $30x = 360^0$ and $x = \dfrac{360^0}{30} = 12^0$

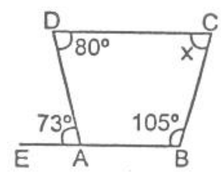
$\therefore$ 1^{st} angle $= 3x = 2 \times 12^0 = 360^0$

2^{nd} angle $= 5x = \; \times 12^0 = 60^0$

3^{rd} angle $= 9x = 9 \times 12^0 = 108^0$

And, 4^{th} angle $= 13 \times 12^0 = 156^0$.

Ex.2 Use the informations given in adjoining figure to calculate the value of x.



Sol. Since, EAB is a straight line.

$\therefore$ $\angle DAE + \angle DAB = 180^0$

$\Rightarrow$ $73^0 + \angle DAB = 180^0$

i.e., $\angle DAB = 180^0 - 73^0 = 107^0$

Since, the sum of the angles of quadrilateral ABCD is 360^0

$\therefore$ $107^0 + 105^0 + x + 80^0 = 360^0$

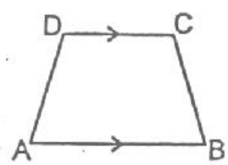
$\Rightarrow$ $292^0 + x = 360^0$

$\Rightarrow$ $x = 360^0 - 292^0$

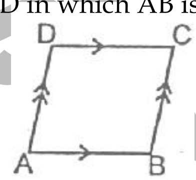
$\Rightarrow$ $x = 68^0$ **Ans.**

(b) Types of Quadrilaterals :

(i) Trapezium : It is a quadrilateral in which one pair of opposite sides are parallel. In the quadrilateral ABCD, drawn alongside, sides AB and DC are parallel, therefore it is a trapezium.



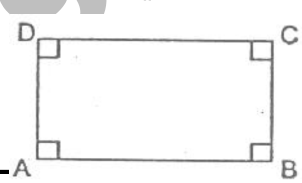
(ii) Parallelogram : It is a quadrilateral in which both the pairs of opposite sides are parallel. The adjoining figure shows a quadrilateral ABCD in which AB is parallel to DC and AD is parallel to BC, therefore ABCD is a parallelogram.



(iii) Rectangle : it is a quadrilateral whose each angle is 90^0

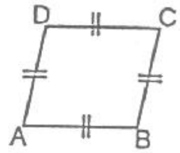
(A) $\angle A + \angle B = 90^0 + 90^0 = 180^0 \Rightarrow AD \parallel BC$

(B) $\angle B + \angle C = 90^0 + 90^0 = 180^0 \Rightarrow AB \parallel DC$

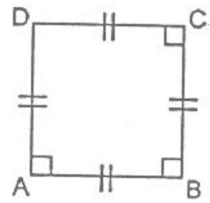


Rectangle ABCD is a parallelogram Also.

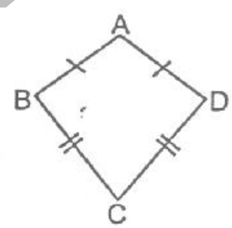
(iv) Rhombus : It is a quadrilateral whose all the sides are equal. The adjoining figure shows a quadrilateral ABCD in which AB = BC = CD = DA ; therefore it is a rhombus.



(v) Square : It is a quadrilateral whose all the sides are equal and each angle is 90^0. The adjoining figure shows a quadrilateral ABCD in which AB = BC = CD = DA and $\angle A = \angle B = \angle C = \angle D = 90^0$, therefore ABCD is a square.



(vi) Kite : It is a quadrilateral in which two pairs of adjacent sides are equal. The adjoining figure shows a quadrilateral ABCD in which adjacent sides AB and AD are equal i.e., AB = AD and also the other pair of adjacent sides are equal i.e., BC = CD; therefore it is a kite or kite shaped figure.



REMARK :

(i) Square, rectangle and rhombus are all parallelograms.

(ii) Kite and trapezium are not parallelograms.

(iii) A square is a rectangle.

(iv) A square is a rhombus.

(v) A parallelogram is a trapezium.