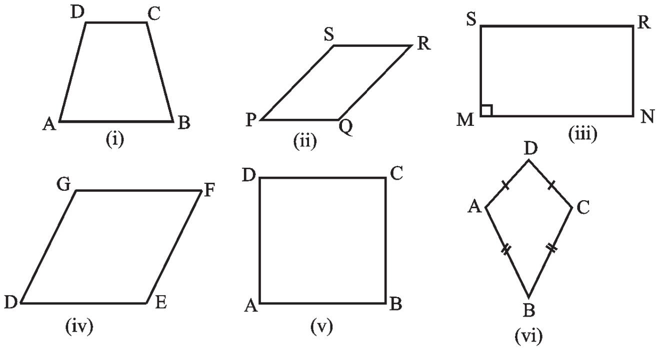
Chapter 8

Quadrilaterals

In the Chapter

- Sum of the angles of a quadrilateral is 360°.
- A diagonal of a parallelogram divides it into two congruent triangles.
- In a parallelogram,
  (i) opposite sides are equal
  (ii) opposite angles are equal
  (iii) diagonals bisect each other
- A quadrilateral is a parallelogram, if
  (i) opposite sides are equal or
  (ii) opposite angles are equal or
  (iii) diagonals bisect each other or
  (iv) a pair of opposite sides is equal and parallel
- Diagonals of a rectangle bisect each other and are equal and vice-versa.
- Diagonals of a rhombus bisect each other at right angles and vice-versa.
- Diagonals of a square bisect each other at right angles and are equal, and vice-versa.
- The line-segment joining the mid-points of any two sides of a triangle is parallel to the third side and is half of it.
- A line through the mid-point of a side of a triangle parallel to another side bisects the third side.
- The quadrilateral formed by joining the mid-points of the sides of a quadrilateral, in order, is a parallelogram.
- Sides, angles and diagonals of a quadrilateral.
- Different types of quadrilatrals : Trapezium, parallelogram, rectangle, rhombus and square.
- A line drawn through the mid-point of a side of a triangle parallel to another side bisects the third side.
- **Types of Quadrilaterals**

Look at the different quadrilaterals drawn below:



Observe that :

- One pair of opposite sides of quadrilateral ABCD in Fig. (i) namely, AB and CD are parallel. You know that it is called a *trapezium*.
- Both pairs of opposite sides of quadrilaterals given in Fig. (ii), (iii) , (iv) and (v) are parallel. Recall that such quadrilaterals are called *parallelograms*. So, quadrilateral PQRS of Fig. 8.5 (ii) is a parallelogram. Similarly, all quadrilaterals given in Fig. (iii), (iv) and (v) are parallelograms.
- In parallelogram MNRS of Fig. 8.5 (iii), note that one of its angles namely $\angle$M is a right angle. What is this special parallelogram called? Try to recall.
  It is called a *rectangle*.
- The parallelogram DEFG of Fig. (iv) has all sides equal and we know that it is called a *rhombus*.
- The parallelogram ABCD of Fig. (v) has $\angle A = 90°$ and all sides equal; it is called a *square*.
- In quadrilateral ABCD of Fig. (vi), AD = CD and AB = CB i.e., two pairs of adjacent sides are equal. It is not a parallelogram. It is called a *kite*.
  Note that a square, rectangle and rhombus are all parallelograms.
- A square is a rectangle and also a rhombus.
- A parallelogram is a trapezium.
- A kite is not a parallelogram.
- A trapezium is not a parallelogram (as only one pair of opposite sides is parallel in a trapezium and we require both pairs to be parallel in a parallelogram).
- A rectangle or a rhombus is not a square.

NCERT TEXT BOOK QUESTION (SOLVED)

EXERCISE 8.1

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

Ans. Let the angles be

$2x, 5x, 9x$ and $13x$

As the sum of the angles of a quadrilaterals is 360°,

$\therefore \quad 3x + 5x + 9x + 13x = 360°$

or $\quad 30x = 360$

or $\quad x = \frac{360}{30} = 12$

$\therefore \quad 3x = 3 \times 12 = 36°$

$5x = 5 \times 12 = 60°$

$9x = 9 \times 12 = 108°$

$13x = 13 \times 12 = 156°$

Hence the angles of the quadrilateral are 36°, 60°, 108° and 156°.

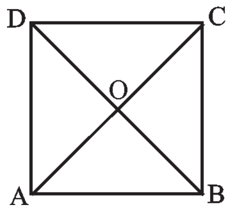
Q.2. If the diagonals of a parallelogram are equal, then show that it is a rectangle.

Ans. Given : A parallelogram ABCD in which diagonal AC = diagonal BD.

To prove : ABCD is a rectangle.

Proof : In ΔABC and ΔDCB.

AC = BD (given)



BC = CB (Common)

AB = DC

(Opposite sides of a parallelogram)

Therefore,

$\Delta ABC \cong \Delta DCB$ (SSS Rule)

$\angle ABC = \angle BCD$ (CPCT)

But $\angle ABC + \angle BCD = 180°$

[Interior angles on the same side of transversal BC and AB || CD]

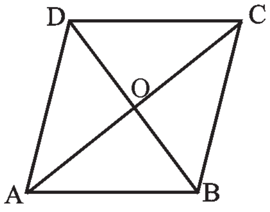
So $\quad 2\angle ABC = 180°$

$\angle ABC = 90°$

Hence parallelogram ABCD is a rectangle.

Q.3. Show that if the diagonals of a quadrilateral bisect each other at right angles, then it is a rhombus.

Ans. Given : A quadrilateral ABCD in which diagonals AC and BD bisect each other at right angles at O.



To prove : Quad. ABCD is a rhombus.

Proof : In ΔAOD and ΔAOB,

$OA = OA$ (common)

$OD = OB$ (given)

$\angle AOD = \angle AOB = 90°$ (given)

Therefore $\Delta AOD = \Delta AOB$ (SAS rule)

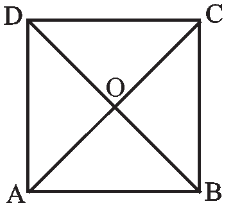
So $AD = AB$ (CPCT)

Similarly, $AB = BC = CD = DA$

Hence, Quadrilateral ABCD is a rhombus.

Q.4. Show that the diagonals of a square are equal and bisect each other at right angles.

Ans. Given : ABCD is a square whose diagonals intersect each other at O.



To prove : (i) $BD = AC$

(ii) $OA = OC, OB = OD$

(iii) $AC \perp BD$

Proof : (i) In ΔDAB and ΔCBA.

$AB = BA$ (Common)

$AD = BC$ (Sides of a square)

$\angle DAB = \angle CBA = 90°$ [Angle of a square]

Therefore $\Delta DAB \cong \Delta CBA$ (SAS rule)

So, $BD = AC$ (CPCT)

(ii) In ΔAOB and ΔCOD

$\angle AOB = \angle COD$ (Vert. opp. angles)

$AB = CD$ (Sides of a square)

$\angle OBA = \angle OCD$ (Alternate angles)

$\therefore$ $\Delta AOB = \Delta COD$ (AAS rule)

Hence $OA = OC$ and $OB = OD$ (CPCT)

(iii) In ΔAOD and ΔCOD

$OA = OC$ (Proved above)

$AD = CD$ (Sides of a square)

$OD = OD$ (Common)

Therefore $\Delta AOD \cong \Delta COD$ (SSS Rule)

Thus $\angle AOD = \angle COD$ (CPCT)

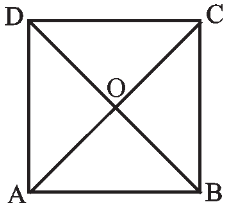
Also $\angle AOD + \angle COD = 180°$ (linear pair)

or $2\angle AOD = 180°$

or $\angle AOD = 90°$

Hence $AC \perp BD$

Q.5. Show that if the diagonals of a quadrilateral are equal and bisect each other at right angles, then it is a square.



To Prove : ABCD is a square.

Proof : Since ABCD is a quadrilateral whose diagonals bisect each other, so it is parallelogram. Also, its diagonals bisect each other at right angles, therefore, ABCD is a rhombus.

$\Rightarrow$ $AB = BC = CD = DA$ [Sides of a rhombus]

In $\Delta ABC = \Delta BAD$, we have

$AB = AB$ (Common)

$BC = AD$ (Sides of a rhombus]

$AC = BD$ (Given)

$\therefore$ $\Delta ABC = \Delta BAD$ (SSS congruence)

$\therefore$ $\angle ABC = \angle BAD$ (CPCT)

But, $\angle ABC + \angle BAD = 180°$ [Consecutive interior angles]

$\angle ABC = \angle BAD = 90°$

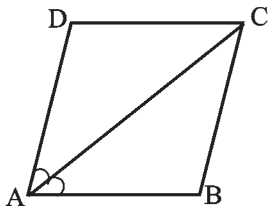
$\angle A = \angle B = \angle C = \angle D = 90°$

[Opposite angles of a || gm]

$\Rightarrow$ ABCD is a rhombus whose angles are of 90° each.

Hence, ABCD is a square.

Q.6. Diagonal AC of a parallelogram ABCD bisects $\angle$ A (see Fig.). Show that



(i) it bisects $\angle$C also,

(ii) ABCD is a rhombus.

Ans. Given : A parallelogram ABCD, in which diagonal AC bisects $\angle A$, i.e., $\angle DAC = \angle BAC$.

To Prove : (i) Diagonal AC bisects $\angle C$

i.e., $\angle DCA = \angle BCA$

(ii) ABCD is a rhombus.

Proof :

(i) $\angle DAC = \angle BCA$ [Alternate angles]

$\angle BAC = \angle DCA$ [Alternate angles]

But, $\angle DAC = \angle BAC$ [given]

$\therefore \angle BCA = \angle DCA$

Hence, AC bisects $\angle DCB$

Or, AC bisects $\angle C$ Proved.

(ii) In ΔABC and ΔCDA

$AC = AC$ [Common]

$\angle BAC = \angle DAC$ [Given]

and $\angle BCA = \angle DCA$ [Proved above]

$\therefore \Delta ABC \cong \Delta ADC$ [ASA congruence]

$\therefore BC = DC$ [CPCT]

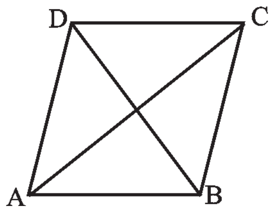
But $AB = DC$ [Given]

Thus, $AB = BC = DC = AD$

Hence, ABCD is a rhombus

Q.7. ABCD is a rhombus. Show that diagonal AC bisects $\angle A$ as well as $\angle C$ and diagonal BD bisects $\angle B$ as well as $\angle D$.

Ans. Given : A rhombus ABCD



To Prove : (i) $\angle BAC = \angle CAD$

(ii) $\angle BCA = \angle DCA$

(iii) $\angle ABD = \angle CBD$

(iv) $\angle COB = \angle ADB$

Proof : In ΔACD,

$AD = CD$

$\therefore \angle DAC = \angle DCA$

(Opposite sides of a Δ)

Now $CD \parallel AB$

$\therefore \angle DAC = \angle BCA$ (Alternate angles)

Therefore

$\angle DCA = \angle BCA$

Hence AC bisects $\angle C$.

Similarly we can prove AC bisects $\angle A$ and BD bisects both $\angle B$ as well as $\angle D$.

Q.8. ABCD is a rectangle in which diagonal AC bisects $\angle A$ as well as $\angle C$. Show that:

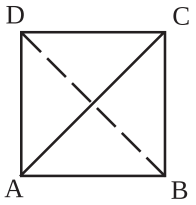
(i) ABCD is a square

(ii) diagonal BD bisects $\angle B$ as well as $\angle D$.

Sol. Given : ABCD is a rectangle in which AC bisects $\angle A$ as well as $\angle C$.

To prove : (i) ABCD is a square.

(ii) Diagonal BD bisects $\angle B$ as well as $\angle D$.



Proof : In ΔACD,

$\angle A = \angle C$

or $\frac{1}{2}\angle A = \frac{1}{2}\angle C$

So $\angle DAC = \angle DCA$

$AD = CD$

[Sides opposite to equal angles]

Hence ABCD is a rhombus and it is given that it is a square.

Hence ABCD is a square.

(ii) In a square, diagonals bisect the angles.

Hence BD bisects both $\angle B$ and $\angle D$.

Q.9. In parallelogram ABCD, two points P and Q are taken on diagonal BD such that DP = BQ (see Fig.). Show that:

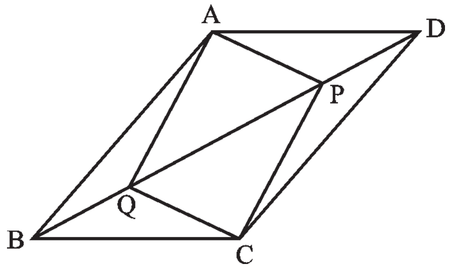
(i) $\Delta APD \cong \Delta CQB$

(ii) AP = CQ

(iii) $\Delta AQB \cong \Delta CPD$

(iv) AQ = CP

(v) APCQ is a parallelogram



Ans. Given : A parallelogram ABCD. There are two points P and Q on two diagonals BD such that DP = BQ.

To Proof :

(i) $\Delta APD \cong \Delta CQB$

(ii) $AB = CQ$

(iii) $\Delta AQB \cong \angle CPD$

(iv) $AQ = CP$

(v) APCQ is a parallelogram

Proof : (i) In ΔAPD and ΔCQB, we have

AD = BC [Opposite sides of a ||gm]

DP = BQ [given]

$\angle$ADP = $\angle$CBQ [Alernate angles]

$\therefore$ ΔAPD $\cong$ ΔCQB [By SAS Axiom]

(ii) AP = CQ (CPCT)

(iii) In ΔAQB and ΔCPD,

AB = CD (Opposite sides of ||gm ABCD)

AQ = CD (Opposite sides of ||gm AQCP)

$\angle$ABQ = $\angle$CDP (Alternate angles)

Hence ΔAQB = ΔCPQ (SAS rule)

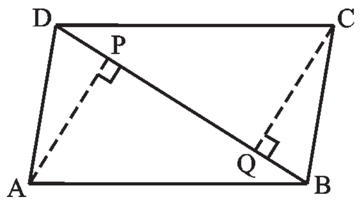
(iv) AQ = CP (CPCT)

(v) Now, AP = CQ (Proved above)

and AQ = CP (Proved above)

Since in APCQ opposite sides are equal, therefore it is a parallelogram.

Q.10. ABCD is a parallelogram and AP and CQ are perpendiculars from vertices A and C on diagonal BD (see Fig.). Show that



(i) ΔAPB $\cong$ ΔCQD

(ii) AP = CQ

Ans. Given : A parallelogam ABCD in which AP and CQ are perpendiculars from vertices A and C on diagonal BD respectively.

To prove : (i) ΔAPB $\cong$ ΔCQD

(ii) AP = CQ

Proof : (i) In ΔAPB and ΔCQD

$\angle$APB = $\angle$CQD = 90° (Given)

$\angle$ABP = $\angle$CDQ (Alternate angles)

AB = CD (Opposite sides of a ||gm)

$\therefore$ ΔAPB = ΔCQD (AAS rule)

(ii) Thus AP = CQ (CPCT)

Q.11. In ΔABC and ΔDEF, AB = DE, AB || DE, BC = EF and BC || EF. Vertices A, B and C are joined to vertices D, E and F respectively (see Fig.). Show that

(i) quadrilateral ABED is a parallelogram

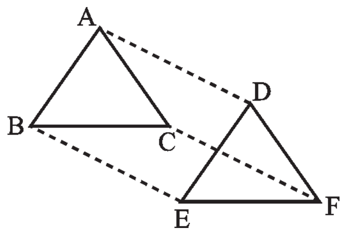
(ii) quadrilateral BEFC is a parallelogram

(iii) AD || CF and AD = CF

(iv) quadrilateral ACFD is a parallelogram

(v) AC = DF

(vi) ΔABC $\cong$ Δ DEF.



Ans. Given : In ΔABC and ΔDEF, AB= DE, AB || DE, BC = EF and BC || EF. Vertices A, B and C are joined to vertices D, E and F.

To prove : (i) ABED is a parallelogram

(ii) BEFC is a parallelogram

(iii) AD || CF and AD = CF

(iv) ACFD is a parallelogram

(v) AC = DF

(vi) ΔABC $\cong$ ΔDEF

Proof : (i) In quadrilatral ABED, we have

AB = DE and AB || DE [Given]

$\Rightarrow$ ABED is a parallelogram [One pair of opposite sides is parallel and equal]

(ii) In quadrilateral BEFC, we have

BC = EF and BC || EF [Given]

$\Rightarrow$ BEFC is a parallelogram. [One pair of opposite sides is parallel and equal]

(iii) BE = CF and BE || CF [BEFC is parallelogram]

AD = BE and AD || BE [ABED is a parallelogram]

$\Rightarrow$ AD = CF and AD || CF

(iv) ACFD is a parallelogram.

[One pair of opposite sides is parallel and equal]

(v) AC = DF [Opposite sides of parallelogram ACFD]

(vi) In ΔABC and ΔDEF, we have

AB = DE [Given]

BC = EF [Given]

AC = DF [Proved above]

$\therefore$ ΔABC $\cong$ ΔDEF [SSS axiom}

Q.12. ABCD is a trapezium in which AB || CD and AD = BC (see Fig.). Show that

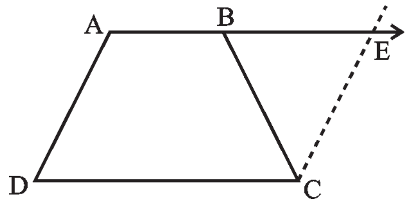
(i) $\angle$A = $\angle$B

(ii) $\angle$C = $\angle$D

(iii) $\Delta ABC \cong \Delta BAD$

(iv) diagonal AC = diagonal BD

[*Hint* : Extend AB and draw a line through C parallel to DA intersecting AB produced at E.]



Ans. Given : ABCD is a trapezium in which AB || CD and AD = BC.

To Prove : (i) $\angle A = \angle B$

(ii) $\angle C = \angle D$

(iii) $\Delta ABC \cong \Delta BAD$

(iv) Diagonal AC = Diagonal BD

Construction : Extend AB and draw a line through C parallel to DA intersecting AB produced at E.

Proof : (i) In quad. ADCE,

AD ∥ CE (By construction)

AE ∥ DC (Given)

So AD = EC and AD = BC

$\therefore$ BC = EC

Therefore

$\angle CBE = \angle BEC$

[Angles opposite to equal sides of a Δ]

$\angle A + \angle E = 180°$

(Interior angles on the same side of transversal AE where AD || EC)

and $\angle E = \angle CBE$

Therefore

$\angle A + \angle CBE = 180°$

But $\angle ABC + \angle CBE = 180°$ (linear pair)

So $\angle A = \angle ABC = \angle B$,

Hence $\angle A = \angle B$

(ii) $\angle A = \angle BCD$ and $\angle B = \angle D$

$\therefore$ $\angle BCD = \angle D$

or $\angle C = \angle D$ in trap ABCD

(iii) In ΔABC and ΔBAD

BC = AD (Given)

AB = BA (Common)

$\angle A = \angle B$

Therefore

$\Delta ABC \cong \Delta BAD$ (SAS rule

(iv) $\therefore$ Diagonal AC = Diagonal BD (CPCT)

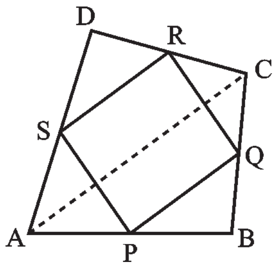
EXERCISE 8.2

Q.1. ABCD is a quadrilateral in which P, Q, R and S are mid-points of the sides AB, BC, CD and DA (see Fig). AC is a diagonal. Show that :

(i) SR || AC and SR = $\frac{1}{2}$ AC

(ii) PQ = SR

(iii) PQRS is a parallelogram.



Ans. Given : ABCD is a quadrilateral in which P, Q, R and S are mid-points of AB, BC, CD and DA. AC is a diagonal.

To prove : (i) SR || AC and SR = $\frac{1}{2}$ AC

(ii) PQ = SR

(iii) PQRS is a parallelogram

Proof : (i) In ΔABC, P is the mid-point of AB and Q is the mid-point of BC.

$\therefore$ PQ || AC and PQ = $\frac{1}{2}$ AC ...(i)

[Mid-point theorem]

In ΔADC, R is the mid-point of CD and S is the mid-point of AD.

$\therefore$ SR || AC and SR = $\frac{1}{2}$ AC ...(ii)

[Mid-point theorem]

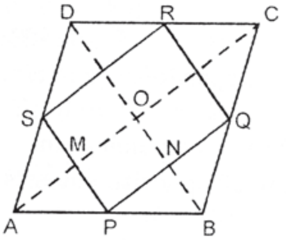
(ii) From (i) and (ii), we get

PQ || SR and PQ = SR

(iii) Now in quadrilateral PQRS, its one pair of opposite sides PQ and SR is equal and parallel.

$\therefore$ PQRS is a parallelogram.

Q.2. ABCD is a rhombus and P, Q, R and S are the mid-points of the sides AB, BC, CD and DA respectively. Show that the quadrilateral PQRS is a rectangle.



Ans. Given : ABCD is a rhombus and P, Q, R and S are the mid-points of the sides AB, BC, CD and DA respectively.

To Prove : Quadrilateral PQRS is a rectangle.

Construction : Join A and C.

Proof : In ΔABC, P is the mid-point of AB and Q is the mid-point of BC.

$\therefore \quad PQ = \frac{1}{2} AC$

and $\quad PQ \parallel AC \quad$ ... (i)

(Mid-point Theorem)

Similarly, $SR = \frac{1}{2} AC$ and $SR \parallel AC \quad$ ...(ii)

(Mid-point Theorem)

$\therefore \quad PQ = SR$ and

$PQ \parallel SR$.

So, PQRS is a parallelogram.

Also, $\quad SP \parallel DB$ and

$RQ \parallel BD$

And $\quad AC \perp BD$

[Diagonals of a rhombus bisect each other at right angle]

$BD \parallel SP$

$\Rightarrow \quad ON \parallel MP$

and $\quad AC \parallel PQ$

$\Rightarrow \quad OM \parallel PN$

$\therefore$ MONP is a $\parallel$gm

$\Rightarrow \angle MON = \angle MPN = 90°$

[opposite angles of a $\parallel$gm]

So, $\quad PQ \perp PS$

Hence PQRS is a rectangle.

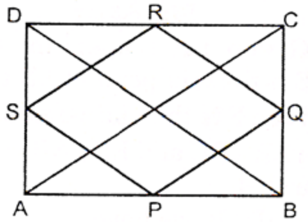
Q.3. ABCD is a rectangle and P, Q, R and S are mid-points of the sides AB, BC, CD and DA respectively. Show that the quadrilateral PQRS is a rhombus.

Ans. Given : ABCD is a rectangle and P, Q, R and S are mid-points of AB, BC, CD and DA respectively.

To prove : PQRS is a rhombus.

Construction : Join AC and BD.

Proof : In ΔABC, P is the mid-point of AB and Q is the mid-point of BC.



$\therefore \quad PQ = \frac{1}{2} AC$

and $\quad PQ \parallel AC \quad$ ... (i)

[Mid-point Theorem]

Also in ΔACD, R is the mid-point of CD and S is the mid-point of AD.

$SR = \frac{1}{2} AC$ and

$SR \parallel AC \quad$ ... (ii)

From (i) and (ii), we get

$SR = PQ$ and $PQ \parallel SR$

Since a pair of opposite sides are equal and parallel.

Therefore, PQRS is a $\parallel$ gm

$\Rightarrow \quad [SR = PQ \text{ and } PS = RQ] \quad$ ...(iii)

Now, in ΔABD

$PS = \frac{1}{2} DB \quad$ ...(iv)

But $\quad AC = DB$

$\Rightarrow \frac{1}{2} AC = \frac{1}{2} DB$

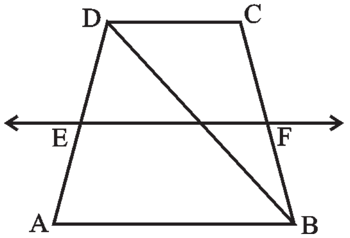
$PQ = PS \quad$ ...(v)

$\Rightarrow$ From (iii), (iv) and (v)

$PQ = QR = RS = SP$

Hence, PQRS is a rhombus. **Proved.**

Q.4. ABCD is a trapezium in which AB || DC, BD is a diagonal and E is the mid-point of AD. A line is drawn through E parallel to AB intersecting BC at F (see Fig.). Show that F is the mid-point of BC.



Ans. ABCD is a trapezium in which AB || DC, BD is a diagonal and E is the mid-point of AD. A line is a drawn through E, parallel to AB intersecting BC at F.

F is the mid-point of BC.

Let EF intersect BD at G.

In ΔABD, EG is the mid-point of DA and EG || AB.

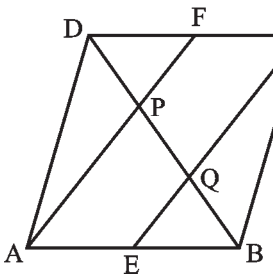
So, G is the mid-point of DB.

Again in ΔDBA,

G is the mid-point of DB and GF | | CD.

$\therefore$ F is the mid-point of BC.

Q.5. In a parallelogram ABCD, E and F are the mid-points of sides AB and CD respectively (see Fig.). Show that the line segments AF and EC trisect the diagonal BD.



Ans. A parallelogram ABCD. E and F are mid-points of sides AB and CD respectively. The line segments AF and EC trisect the diagonal BD or DP PQ = QB.

$$AE = \frac{1}{2} AB \text{ and } FC = \frac{1}{2} CD$$

But AB || CD and AB = CD,

(Opposite sides of parallelogram)

$\therefore$ AE = FC and AE = FC

Thus, AECF is a paralleogram.

Now, F is the mid-point of DC and FP | | CQ.

$\therefore$ P is the mid-point of DQ.

(Mid-point theorem)

Similarly, Q is the mid-points of BP.

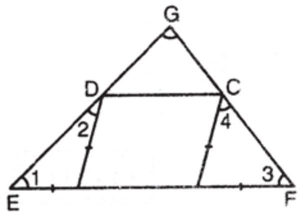
Thus, DP = PQ = QB. **(Proved)**

Q.6. Show that the line segments joining the mid-points of the opposite sides of a quadrilateral bisect each other.

Ans. Given : A quadrilateral ABCD in which P, Q, R and S are the mid-points of AB, BC, CD and DA, PR and SQ intersect each other.

To prove : PR and SQ bisect each other.

Proof : In ΔABC, P is the mid-point of AB and Q is the mid-point of BC.



$\therefore$ PQ | | AC and PQ = $\frac{1}{2}$ AC ... (i)

Similarly, SR | | AC and SR $\frac{1}{2}$ AC ...(ii)

From Equation (i) and (ii), we get

PQRS is a parallelogram.

We know that diagonals of a parallelogram bisect each other.

Hence, PR and SQ bisect each other.

Q.7. ABC is a triangle right angled at C. A line through the mid-point M of hypotenuse AB and parallel to BC intersects AC at D. Show that

(i) D is the mid-point of AC

(ii) MD $\perp$ AC

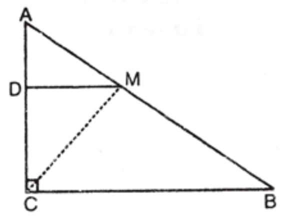
(iii) CM = MA = $\frac{1}{2}$ AB

Ans. Given : ABC is a right angled triangle at C. A line through the mid-point M of hypotenuse AB and parallel to BC intersects AC at D.

To prove : (i) D is the mid-point of AC

(ii) MD $\perp$ AC

(iii) CM = MA = $\frac{1}{2}$ AB.



Proof : (i) In ΔABC, M is the mid-point of AB and MD | | BC. So, D is the mid-point of AC.

(ii) MD | | BC

$\therefore$ $\angle$BCD = $\angle$MDA

But $\angle$BCD = rt. angle

$\therefore$ $\angle$MDA = rt. angle

Hence, MD $\perp$ AC.

(iii) A and M is the mid-point of AB.

$\therefore$ AM = MB

In ΔADM and ΔCDM ;

$$DM = DM$$
$$\angle ADM = \angle CDM$$
(Proved above each = 90°)
$$AD = CD, \quad \text{(Proved above)}$$

$\therefore$ $\Delta ADM = \Delta CDM$ (SAS rule)

So, $AM = CM$ (CPCT)

Hence, $CM = AM = \frac{1}{2} AB$. (Proved)

Additional Questions

Q.1. Diagonals of a rectangle are equal and perpendicular. Is this statement true? Give reason for your answer.

Ans. No. Diagonals of a rectangle are equal but need not be perpendicular.

Q.2. All the angles of a quadrilateral are equal. What special name is given to this quadrilateral?

Ans. In rectangle all angles are equal.

Q.3. In quadrilateral ABCD, $\angle A + \angle D = 180°$. What special name can be given to this quadrilateral?

Ans. It is a trapezium because sum of interior angles is 180°.

Q.4. Diagonals of a parallelogram are perpendicular to each other. Is this statement true? Give reason for your answer.

Ans. No. Diagonals of a parallelogram are not perpendicular to each other. They only bisect each other.

Q.5. Can the angles 110°, 80°, 70° and 95° be the angles of a quadrilateral? Why or why not?

Ans. No. We know that, sum of the angles of a quadrillateral is 360°.

Here, sum of the angles = 110° + 80° + 70° + 95° = 355°.

So, these angles cannot be the angles of a quadrilateral.

Q.6. Can all the angles of a quadrilatral be acute angles? Give reason for your answer.

Ans. No. All the angles of a quadrilateral cannot be acute angles. Since, sum of the angles of a quadrilateral is 360°.

Q.7. Can all the angles of a quadrilateral be right angles ? Give reason for your answer.

Ans. Yes, all the angles of a quadrilatral be right angles. In this case, the quadrilateral becomes rectangle or square.

Q.8. Opposite angles of a quadrilatral ABCD are equal. If AB = 4 cm, determine CD.

Ans. Given, opposite angles of a quadrilateral are equal. So, ABCD is a parallelogram and we know that in a parallelogram opposite sides are also equal.

$\therefore$ $CD = AB = 4$ cm

Q.9. One angle of a quadrilateral is of 180° and the remaining three angles are equal. Find each of the three equal angles.

Ans. Let each of the three equal angles is of x°.

Now, sum of angles of a quadrilateral = 360°

$\Rightarrow$ $108° + x° + x° + x° = 360°$

$\Rightarrow$ $3x° = 360° - 108°$

$\Rightarrow$ $x° = \frac{252°}{3}$

$\Rightarrow$ $x° = 84°$

Hence, each of the three equal angles = 84°.

Q.10. Show that each angle of a rectangle is a right angle.

Ans. We have ABCD as a rectangle

$\Rightarrow$ ABCD is a parallelogram

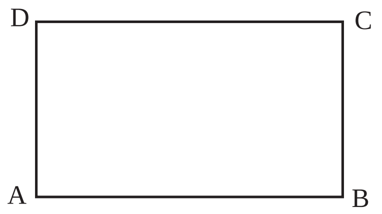
$\Rightarrow$ $AD \parallel BC$

Now, $AD \parallel BC$ and AB intersects them at A and B.

$\therefore$ $\angle A + \angle B = 180°$

[Sum of the interior angles on the same side of a transversal is 180°]

$\Rightarrow$ $90° + \angle B = 180°$ [$\angle A = 90°$ (given)]



Similarly, we can show that $\angle C = 90°$ and $\angle 90°$.

Hence, $\angle A = \angle B = \angle C = \angle D = 90°$

Multiple Choice Questions

Q.1. In a quadrilateral, if one of angle is 90° and opposite sides are equal, then it is a:

(a) rhombus (b) trapezium
(c) rectangle (d) square

Ans. (c) rectangle

Q.2. The bisectors of the angles of parallelogram form a:

(a) trapezium (b) paralleogram
(c) rectangle (d) square

Ans. (c) rectangle

Q.3. When each angle of a rhombus is of 90°, it is called a:

(a) square (b) paralleogram
(c) rectangle (d) trapezium

Ans. (a) square

Q.4. If the diagonals of a quadrilateral bisect each other at right angles, then it is a:

(a) trapezium (b) rectangle
(c) rhombus (d) paralleogram

Ans. (c) rhombus

Q.5. The perimeter of a parallelogram is 28 cm, if shorter sides measure 4.5 cm, then measure of the longer side is:

(a) 9.5 cm (b) 9 cm
(c) 6.5 cm (d) 7.5 cm

Ans. 9.5 cm

Q.6. In a parallelogram, if the adjacent angles are $(3x+10)°$ and $(5x+30)°$, then value of x is:

(a) 20° (b) 25°
(c)30° (d) 40°

Ans. (b) 25°

Q.7. If an angle of a parallelogram is two third of its adjacent angle, the smallest angle of the parallelogram is:

(a) 108° (b) 72°
(c) 54° (d) 126°

Ans. (b) 72°

Q.8. If the diagonals of a parallelogram are equal, then it is a:

(a) rhombus (b) trapezium
(c) rectangle (d) square

Ans. (c) rectangle

Q.9. If the diagonals of a quadrilateral bisect the opposite angle, then it is a:

(a) square (b) paralleogram
(c) rectangle (d) trapezium

Ans. (a) square

Q.10. If ABCD is a paralleogram, then $\angle A - \angle C$ is equal to:

(a) 90° (b) 45°
(c) 180° (d) 0°

Ans. (d) 0°