NCERT Solutions Class 9 Maths
Chapter 8: Quadrilaterals
EXERCISE 8.1

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Quick Summary: In NCERT Solutions Class 9 Maths Chapter 8 Exercise 8.1, students learn the fundamental properties of parallelograms and their special cases including rectangles, squares, and rhombus. This exercise covers essential geometric proofs using the Mid-point Theorem and parallelogram properties, which are crucial topics for CBSE Class 9 board exams and form the foundation for advanced geometry concepts.

Key Takeaways:

- Mid-point Theorem: The line segment joining the midpoints of two sides of a triangle is parallel to the third side and equal to half of it, i.e., MN = (1)/(2)BC
- In a parallelogram, opposite sides are equal and parallel, opposite angles are equal, and diagonals bisect each other
- A parallelogram with equal diagonals is always a rectangle, and all properties of rectangles, squares, and rhombus can be proven using parallelogram properties
- These proofs are frequently asked in CBSE exams and help develop logical reasoning skills essential for higher-level geometry

Complete Solutions

Question 1

QUESTION

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

SOLUTION

This question asks us to prove that if the diagonals of a parallelogram are equal, then the parallelogram must be a rectangle. This tests our understanding of the properties of parallelograms and rectangles.

Step 1: Draw the parallelogram and label it

Let ABCD be a parallelogram where the diagonals AC and BD are equal, i.e., AC = BD. We need to prove that ABCD is a rectangle.

Step 2: Consider triangles ABC and ABD

In triangles ABC and ABD, we have:

AB = AB (Common side)

BC = AD (Opposite sides of a parallelogram are equal)

AC = BD (Given that the diagonals are equal)

Step 3: Apply the SSS congruence rule

By the SSS (Side-Side-Side) congruence rule, we can say that:

Step 4: Use CPCT to find equal angles

Since the triangles are congruent, their corresponding parts must be equal (CPCT - Corresponding Parts of Congruent Triangles). Therefore:

Step 5: Use the property of adjacent angles in a parallelogram

Since ABCD is a parallelogram, adjacent angles are supplementary (add up to 180 degrees). Therefore:

Step 6: Substitute and solve for the angles

Since , we can substitute:

Therefore, as well.

Step 7: Conclude that the parallelogram is a rectangle

Since one angle of the parallelogram ABCD is , and opposite angles in a parallelogram are equal, all angles are . A parallelogram with all angles equal to is a rectangle.

Therefore, if the diagonals of a parallelogram are equal, then it is a rectangle.

Question 2

QUESTION

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

SOLUTION

We need to prove that the diagonals of a square are equal in length, bisect each other, and intersect at right angles.

Step 1: Draw a square and its diagonals

Let ABCD be a square. Let AC and BD be its diagonals, intersecting at point O.

Step 2: Prove that the diagonals are equal (AC = BD)

Consider triangles ABC and BAD.

AB = BA (Common side)

BC = AD (Sides of a square are equal)

(Each angle of a square is a right angle)

Therefore, by the SAS (Side-Angle-Side) congruence rule.

By CPCT (Corresponding Parts of Congruent Triangles), AC = BD.

Hence, the diagonals of a square are equal.

Step 3: Prove that the diagonals bisect each other (OA = OC and OB = OD)

Consider triangles AOB and COD.

(Alternate interior angles, as AB || CD)

(Alternate interior angles, as AB || CD)

AB = CD (Sides of a square are equal)

Therefore, by the ASA (Angle-Side-Angle) congruence rule.

By CPCT, OA = OC and OB = OD.

Hence, the diagonals bisect each other.

Step 4: Prove that the diagonals intersect at right angles ()

Consider triangles AOB and BOC.

OA = OC (Diagonals bisect each other)

OB = OB (Common side)

AB = BC (Sides of a square are equal)

Therefore, by the SSS (Side-Side-Side) congruence rule.

By CPCT, .

Since (Linear pair), we have , which means .

Hence, the diagonals intersect at right angles.

Final Answer: The diagonals of a square are equal and bisect each other at right angles.

Question 3

QUESTION

Diagonal AC of a parallelogram ABCD bisects \angle A. Show that:

(i) it bisects \angle C also,

(ii) ABCD is a rhombus.

SOLUTION

This question tests our understanding of parallelograms, angle bisectors, and the properties of a rhombus. We need to prove that if the diagonal of parallelogram bisects , then it also bisects , and that is a rhombus.

(i) Proving bisects

Step 1: State what is given

Given that is a parallelogram, and bisects , which means .

Step 2: Use properties of parallelograms

Since is a parallelogram, and .

Step 3: Use properties of parallel lines and transversals

Because , (alternate interior angles).

Because , (alternate interior angles).

Step 4: Combine the information

We know (given).

Also, and .

Therefore, .

Step 5: Conclude

Since , bisects .

(ii) Proving is a rhombus

Step 1: Use the results from part (i)

We know (since and).

Step 2: Use the property that sides opposite equal angles are equal

In , since , we have .

Step 3: Use the property of parallelograms

Since is a parallelogram, opposite sides are equal. Thus, and .

Step 4: Combine the information

We have and and . Therefore, .

Step 5: Conclude

Since all sides of are equal, is a rhombus.

ANSWER

(i) From \triangle DAC and \triangle BCA, show \angle DAC = \angle BCA and \angle ACD = \angle CAB, etc.

(ii) Show \angle BAC = \angle BCA, using Theorem 8.4.

Question 4

QUESTION

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.

SOLUTION

This question tests our understanding of the properties of rectangles, squares, and angle bisectors. We need to prove that if the diagonal of a rectangle bisects and , then is a square and the diagonal bisects and .

(i) Proving is a square:

Step 1: Since bisects , we have .

Since is a rectangle, . Therefore, .

Step 2: Similarly, since bisects , we have .

Since is a rectangle, . Therefore, .

Step 3: Consider triangle . We know and .

Using the angle sum property of a triangle, .

Step 4: Now, consider triangle . We know and .

Therefore, .

Step 5: In triangle , since , the sides opposite to these angles are equal. Therefore, .

Step 6: Since is a rectangle, opposite sides are equal. So, and .

But we have . Therefore, . All sides are equal.

Step 7: Since all sides of rectangle are equal, is a square.

(ii) Proving bisects as well as :

Step 1: Since is a square, .

Step 2: Consider triangle . Since , .

Step 3: Since and , we have , so .

Therefore, bisects and .

Final Answer: (i) is a square, (ii) diagonal bisects as well as .

Question 5

QUESTION

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

(i) \triangle APD \cong \triangle CQB

(ii) AP = CQ

(iii) \triangle AQB \cong \triangle CPD

(iv) AQ = CP

(v) APCQ is a parallelogram

SOLUTION

This question tests our understanding of parallelograms and congruent triangles. We need to prove several relationships based on the given condition in parallelogram .

(i)

Step 1: Identify known information

We know that is a parallelogram, so (opposite sides of a parallelogram are equal) and (alternate interior angles as). Also, it is given that .

Step 2: Apply the SAS congruence rule

In and :

(Opposite sides of parallelogram)

(Alternate interior angles,)

(Given)

Therefore, by the SAS (Side-Angle-Side) congruence rule, .

(ii)

Step 1: Use the result from part (i)

Since (proved above), their corresponding parts are equal by CPCT (Corresponding Parts of Congruent Triangles).

Step 2: Apply CPCT

Therefore, (CPCT).

(iii)

Step 1: Identify known information

We know that is a parallelogram, so (opposite sides of a parallelogram are equal) and (alternate interior angles as). Also, it is given that .

Step 2: Apply the SAS congruence rule

In and :

(Opposite sides of parallelogram)

(Alternate interior angles,)

(Given)

Therefore, by the SAS (Side-Angle-Side) congruence rule, .

(iv)

Step 1: Use the result from part (iii)

Since (proved above), their corresponding parts are equal by CPCT (Corresponding Parts of Congruent Triangles).

Step 2: Apply CPCT

Therefore, (CPCT).

(v) is a parallelogram

Step 1: Use the results from parts (ii) and (iv)

We have already proved that and .

Step 2: Apply the parallelogram property

Since the opposite sides of quadrilateral are equal (i.e., and), is a parallelogram.

Question 6

QUESTION

ABCD is a parallelogram and AP and CQ are perpendiculars from vertices A and C on diagonal BD. Show that:

(i) \triangle APB \cong \triangle CQD

(ii) AP = CQ

SOLUTION

This question tests our understanding of congruent triangles, properties of parallelograms, and perpendicular distances.

(i) Proving

Step 1: Identify the given information.

We are given that is a parallelogram, and and are perpendiculars to the diagonal .

Step 2: List the properties of a parallelogram.

Since is a parallelogram, opposite sides are equal and parallel. Therefore, and .

Step 3: Identify equal angles.

Since , (alternate interior angles).

Also, (given that and are perpendiculars).

Step 4: Apply the AAS congruence rule.

In and :

(each)

(alternate interior angles)

(opposite sides of a parallelogram)

Therefore, by the Angle-Angle-Side (AAS) congruence rule, .

(ii) Proving

Step 1: Use the result from part (i).

Since we have already proved that , we can use the property that corresponding parts of congruent triangles are equal (CPCT).

Step 2: Apply CPCT.

By CPCT, .

Final Answer:

(i)

(ii)

Question 7

QUESTION

ABCD is a trapezium in which AB \parallel CD and AD = BC. Show that:

(i) \angle A = \angle B

(ii) \angle C = \angle D

(iii) \triangle ABC \cong \triangle BAD

(iv) diagonal AC = BD

SOLUTION

This question involves proving several properties of an isosceles trapezium, including angle equality and triangle congruence. We will use geometric constructions and congruence rules to prove each part.

(i) To prove:

Step 1: Construction

Extend and draw a line through parallel to , intersecting produced at . This creates parallelogram .

Step 2: Properties of Parallelogram

Since is a parallelogram, and . Also, (given).

Step 3: Deduce

Since and , we have .

Step 4: Angle Properties

In , since , (angles opposite equal sides are equal).

Step 5: Relate angles

(co-interior angles as). Also, (linear pair).

Step 6: Conclude

Since , we have .

(ii) To prove:

Step 1: Use previous result

We know .

Step 2: Angle Sum Property

and (co-interior angles as).

Step 3: Conclude

Since , we can say .

(iii) To prove:

Step 1: Identify common elements

In and :

(common)

(given)

(proved above)

Step 2: Apply SAS congruence

By SAS congruence rule, .

(iv) To prove: diagonal

Step 1: Use congruent triangles

Since , their corresponding parts are equal (CPCT).

Step 2: Conclude

Therefore, .

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📐 Key Formulas

Important Formulas for Exercise 8.1

Formula / Concept	Description
Angle Sum Property of a Quadrilateral	The sum of the interior angles of any quadrilateral is 360°.
Properties of a Parallelogram	A quadrilateral is a parallelogram if it satisfies any of the following conditions:
1. Opposite Sides	Opposite sides are equal and parallel. If ABCD is a parallelogram, then AB = DC, AD = BC, $AB \parallel DC$, and $AD \parallel BC$.
2. Opposite Angles	Opposite angles are equal. In parallelogram ABCD, $\angle A = \angle C$ and $\angle B = \angle D$.
3. Consecutive Angles	Consecutive angles are supplementary. For parallelogram ABCD, $\angle A + \angle B = 180^\circ$, $\angle B + \angle C = 180^\circ$, etc.
4. Diagonals	The diagonals bisect each other. If diagonals AC and BD intersect at O, then AO = OC and BO = OD.
5. Diagonal and Congruency	Each diagonal divides the parallelogram into two congruent triangles. For parallelogram ABCD, $\triangle ABC \cong \triangle CDA$ and $\triangle ABD \cong \triangle CDB$.
Theorem: Condition for a Parallelogram	A quadrilateral is a parallelogram if one pair of opposite sides is equal and parallel.
Mid-point Theorem	The line segment joining the mid-points of any two sides of a triangle is parallel to the third side and is equal to half of it. If D and E are mid-points of sides AB and AC of $\triangle ABC$, then $DE \parallel BC$ and $DE = \frac{1}{2} BC$.
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.

❓ Top FAQs

Q1. How many questions are in NCERT Solutions Class 9 Maths Chapter 8 Quadrilaterals Exercise 8.1 for CBSE 2025-26?

There are exactly 7 questions in NCERT Solutions for Class 9 Maths Chapter 8 Quadrilaterals Exercise 8.1. These questions focus on the properties of parallelograms and the Mid-point Theorem, which are essential for the CBSE board exam 2025-26 session.

Q2. Where can I download free PDF of NCERT Solutions for Class 9 Maths Chapter 8 Quadrilaterals Exercise 8.1 with step by step solutions?

You can download the free PDF of NCERT Solutions for Class 9 Maths Chapter 8 Quadrilaterals Exercise 8.1 from the official NCERT website or various educational portals. These PDFs include detailed step by step solutions for all 7 questions, updated according to the CBSE syllabus 2025-26.

Q3. How many marks does Chapter 8 Quadrilaterals carry in CBSE Class 9 Maths board exam 2025-26?

Chapter 8 Quadrilaterals carries approximately 5 marks in the CBSE Class 9 Maths board exam 2025-26 under Unit IV - Geometry. The weightage is shared with other geometry chapters, making Exercise 8.1 and its concepts crucial for scoring well in the examination.

Q4. Which is the most difficult question in Exercise 8.1 of NCERT Class 9 Maths Chapter 8 Quadrilaterals for CBSE 2025-26?

Questions 5, 6, and 7 in Exercise 8.1 of Class 9 Maths Chapter 8 Quadrilaterals are considered the most difficult as they require application of the Mid-point Theorem and properties of parallelograms. These questions involve multiple steps and require thorough understanding of quadrilateral properties for the CBSE board exam 2025-26.

Q5. What is Mid-point Theorem in NCERT Solutions Class 9 Maths Chapter 8 Quadrilaterals Exercise 8.1?

The Mid-point Theorem in NCERT Class 9 Maths Chapter 8 states that the line segment joining the mid-points of two sides of a triangle is parallel to the third side and equal to half of it. This theorem is extensively used in Exercise 8.1 to solve problems related to quadrilaterals and is important for CBSE board exam 2025-26.

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