NCERT Solutions Class 9 Maths
Chapter 8: Quadrilaterals
EXERCISE 8.2

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Quick Summary: In NCERT Solutions Class 9 Maths Chapter 8 Exercise 8.2, students learn the Mid-point Theorem and its applications in proving properties of quadrilaterals including parallelograms, rectangles, rhombus, and trapeziums. This exercise covers fundamental geometric relationships that are essential for CBSE Class 9 board exams and builds strong problem-solving skills for coordinate geometry in higher classes.

Key Takeaways:

- Mid-point Theorem: The line segment joining the mid-points of two sides of a triangle is parallel to the third side and half its length, expressed as MN = (1)/(2)BC
- When mid-points of sides of any quadrilateral are joined, they always form a parallelogram regardless of the original quadrilateral's shape
- In a rhombus, joining mid-points of adjacent sides creates a rectangle, while in a rectangle, this creates a rhombus
- Converse of Mid-point Theorem helps prove that a line trisects segments and establish relationships in trapeziums

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Question 1

QUESTION

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

(i) SR ⫽ AC and SR = 1/2 AC

(ii) PQ = SR

(iii) PQRS is a parallelogram.

SOLUTION

This question involves the mid-point theorem and its application in proving relationships between sides and diagonals of a quadrilateral, ultimately showing that a specific quadrilateral formed by the midpoints is a parallelogram.

(i) SR ⫽ AC and SR = 1/2 AC

Step 1: Consider triangle ADC

In triangle ADC, S is the midpoint of AD and R is the midpoint of DC.

Step 2: Apply the Mid-Point Theorem

By the Mid-Point Theorem, the line segment joining the midpoints of any two sides of a triangle is parallel to the third side and is also half of the third side.

Therefore, SR ⫽ AC and

(ii) PQ = SR

Step 1: Consider triangle ABC

In triangle ABC, P is the midpoint of AB and Q is the midpoint of BC.

Step 2: Apply the Mid-Point Theorem

By the Mid-Point Theorem, PQ ⫽ AC and

Step 3: Compare PQ and SR

From part (i), we know . Also, .

Therefore,

(iii) PQRS is a parallelogram.

Step 1: Use results from previous parts

From part (i), we have SR ⫽ AC. From part (ii), we have PQ ⫽ AC and PQ = SR.

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Step 2: Deduce PQ ∥ SR

Since both PQ and SR are parallel to AC, it implies that PQ ∥ SR.

Step 3: State the properties of a parallelogram

A quadrilateral is a parallelogram if one pair of opposite sides are equal and parallel.

Step 4: Conclude

Since PQ = SR and PQ ∥ SR, PQRS is a parallelogram.

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Question 2

QUESTION

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.

SOLUTION

This question tests our understanding of the properties of a rhombus, mid-point theorem, and how these properties combine to form a rectangle.

Step 1: Draw the diagram and mark midpoints

Draw rhombus ABCD. Mark P, Q, R, and S as the midpoints of sides AB, BC, CD, and DA respectively. Join PQ, QR, RS, and SP to form quadrilateral PQRS.

Step 2: Apply the Mid-Point Theorem in triangle ABC

In triangle ABC, P and Q are the midpoints of AB and BC respectively. By the midpoint theorem, PQ is parallel to AC and .

Step 3: Apply the Mid-Point Theorem in triangle ADC

In triangle ADC, S and R are the midpoints of AD and CD respectively. By the midpoint theorem, SR is parallel to AC and .

Step 4: Show PQRS is a parallelogram

Since PQ is parallel to AC and SR is parallel to AC, then PQ is parallel to SR. Also, and , so PQ = SR. Since one pair of opposite sides (PQ and SR) are equal and parallel, PQRS is a parallelogram.

Step 5: Apply the Mid-Point Theorem in triangle BCD

In triangle BCD, Q and R are the midpoints of BC and CD respectively. By the midpoint theorem, QR is parallel to BD.

Step 6: Properties of a Rhombus

In a rhombus, the diagonals are perpendicular bisectors of each other. Therefore, AC is perpendicular to BD.

Step 7: Show PQRS is a rectangle

Since PQ is parallel to AC and QR is parallel to BD, and AC is perpendicular to BD, then PQ is perpendicular to QR. This means . Since PQRS is a parallelogram with one angle equal to 90 degrees, PQRS is a rectangle.

Final Answer: PQRS is a rectangle.

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ANSWER

Show PQRS is a parallelogram. Also show PQ ∥ AC and PS ∥ BD. So, ∠P = 90°.

Question 3

QUESTION

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.

SOLUTION

We are given a rectangle ABCD, and P, Q, R, and S are the mid-points of sides AB, BC, CD, and DA respectively. We need to prove that the quadrilateral PQRS is a rhombus.

Step 1: Draw the figure and join the midpoints

Draw rectangle ABCD. Mark the midpoints P, Q, R, and S on sides AB, BC, CD, and DA respectively. Join PQ, QR, RS, and SP to form quadrilateral PQRS. Also, join AC and BD.

Step 2: Use the midpoint theorem in triangles

In triangle ABC, P and Q are midpoints of AB and BC respectively. By the midpoint theorem, PQ || AC and . Similarly, in triangle ADC, R and S are midpoints of CD and DA respectively. Therefore, RS || AC and .

Step 3: Establish PQRS as a parallelogram

Since PQ || AC and RS || AC, we have PQ || RS. Also, and , so PQ = RS. Since one pair of opposite sides (PQ and RS) are parallel and equal, PQRS is a parallelogram.

Step 4: Prove adjacent sides are equal

In triangle ABS, P and S are midpoints of AB and AD respectively. Therefore, and PS || BD. Since ABCD is a rectangle, its diagonals are equal, i.e., AC = BD. Thus, . Since PQ = PS, adjacent sides of parallelogram PQRS are equal.

Step 5: Conclude that PQRS is a rhombus

Since PQRS is a parallelogram with adjacent sides equal (PQ = PS), it is a rhombus.

Therefore, quadrilateral PQRS is a rhombus.

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Question 4

QUESTION

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. Show that F is the mid-point of BC.

SOLUTION

This question tests our understanding of the Mid-Point Theorem and its converse, applied within a trapezium.

Step 1: Visualize and draw the figure.

Draw trapezium ABCD with AB ∥ DC. Draw diagonal BD. Mark E as the midpoint of AD. Draw a line through E parallel to AB, intersecting BC at F.

Step 2: Identify the key elements and given information.

We are given:

- ABCD is a trapezium with AB ∥ DC
- E is the midpoint of AD
- EF ∥ AB

We need to prove that F is the midpoint of BC.

Step 3: Introduce a point G where EF intersects BD.

Let the line through E parallel to AB intersect BD at point G.

Step 4: Apply the Converse of the Mid-Point Theorem in triangle ABD.

In triangle ABD, E is the midpoint of AD, and EG ∥ AB. Therefore, by the converse of the Mid-Point Theorem, G must be the midpoint of BD.

Step 5: Apply the Mid-Point Theorem in triangle BCD.

Now consider triangle BCD. We know that G is the midpoint of BD. Also, since EF ∥ AB and AB ∥ DC, we have GF ∥ DC.

Therefore, in triangle BCD, G is the midpoint of BD and GF ∥ DC. By the converse of the Mid-Point Theorem, F must be the midpoint of BC.

Step 6: Conclude.

Thus, F is the midpoint of BC.

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Question 5

QUESTION

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

SOLUTION

This question tests our understanding of parallelograms, mid-point theorem, and how to prove that a line is trisected.

Step 1: Draw the diagram and state what is given

Draw parallelogram ABCD. Mark E as the midpoint of AB and F as the midpoint of CD. Draw the diagonal BD. Draw line segments AF and EC intersecting BD at points P and Q, respectively. We need to prove that DP = PQ = QB.

Step 2: Prove that AECF is a parallelogram

Since ABCD is a parallelogram, AB || CD and AB = CD.

E and F are midpoints of AB and CD respectively, so AE = AB and CF = CD.

Therefore, AE = CF and AE || CF. A quadrilateral with one pair of opposite sides equal and parallel is a parallelogram. Hence, AECF is a parallelogram.

Step 3: Use the properties of parallelogram AECF

Since AECF is a parallelogram, AF || EC.

Consider triangle APB. E is the midpoint of AB and EQ || AP (since EC || AF). By the converse of the midpoint theorem, Q is the midpoint of BP. Therefore, BQ = QP.

Step 4: Apply similar logic to another triangle

Now consider triangle DQC. F is the midpoint of CD and FP || CQ (since AF || EC). By the converse of the midpoint theorem, P is the midpoint of DQ. Therefore, DP = PQ.

Step 5: Combine the results

We have BQ = QP and DP = PQ. Therefore, DP = PQ = QB.

Final Answer:

Hence, the line segments AF and EC trisect the diagonal BD.

ANSWER

AECF is a parallelogram. So, AF ∥ CE, etc.

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Question 6

QUESTION

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 ⊥ AC

(iii) CM = MA = 1/2 AB

SOLUTION

This question involves proving properties of a right-angled triangle using the midpoint theorem and properties of parallel lines.

(i) Proving D is the midpoint of AC

Step 1: State the given information

We are given that M is the midpoint of AB, and MD is parallel to BC.

Step 2: Apply the Midpoint Theorem

In triangle ABC, M is the midpoint of AB, and MD || BC. By the converse of the midpoint theorem, a line drawn through the midpoint of one side of a triangle, parallel to another side, bisects the third side.

Step 3: Conclude

Therefore, D is the midpoint of AC.

(ii) Proving MD ⊥ AC

Step 1: Use the properties of parallel lines

Since MD || BC and AC is a transversal, the corresponding angles are equal.

Step 2: Identify the corresponding angles

Step 3: Use the given information about the right angle

We are given that .

Step 4: Substitute and conclude

Therefore, , which means MD ⊥ AC.

(iii) Proving CM = MA = 1/2 AB

Step 1: Use the fact that D is the midpoint of AC

Since D is the midpoint of AC, AD = DC.

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Step 2: Consider triangles AMD and CMD

In triangles AMD and CMD:

AD = DC (D is the midpoint)

(MD ⊥ AC)

MD = MD (Common side)

Step 3: Apply the SAS congruence rule

By the SAS congruence rule, .

Step 4: Use CPCT

Therefore, MA = MC (By CPCT - Corresponding Parts of Congruent Triangles).

Step 5: Use the given information about M being the midpoint of AB

Since M is the midpoint of AB, MA = 1/2 AB.

Step 6: Conclude

Therefore, CM = MA = 1/2 AB.

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📐 Key Formulas

Important Formulas for Exercise 8.2

Formula / Concept	Description
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 a triangle ABC, then DE \parallel BC and DE = (1)/(2) BC.

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Formula / Concept	Description
Converse of the Mid-point Theorem	The line drawn through the mid-point of one side of a triangle, parallel to another side, bisects the third side.
Properties of a Parallelogram	A quadrilateral is a parallelogram if any one of the following is true: • Opposite sides are parallel. • Opposite sides are equal. • Opposite angles are equal. • Diagonals bisect each other. • One pair of opposite sides is both equal and parallel.
Consecutive Angles of a Parallelogram	The consecutive angles of a parallelogram are supplementary, meaning their sum is 180^\circ. For a parallelogram ABCD, \angle A + \angle B = 180^\circ.
Diagonals of a Parallelogram	The diagonals of a parallelogram bisect each other. Each diagonal also divides the parallelogram into two congruent triangles.
Quadrilateral formed by joining mid-points	The quadrilateral formed by joining the mid-points of the sides of any quadrilateral, in order, is a parallelogram.

❓ Top FAQs

Q1. How many questions are in NCERT Solutions Class 9 Maths Chapter 8 Quadrilaterals Exercise 8.2?

NCERT Solutions for Class 9 Maths Chapter 8 Quadrilaterals Exercise 8.2 contains exactly 6 questions. These questions primarily focus on the Mid-point Theorem and its applications in proving properties of quadrilaterals. All 6 questions are important for CBSE board exam 2025-26 preparation and carry weightage in Unit IV - Geometry.

Q2. Where can I download free PDF of NCERT Solutions for Class 9 Maths Chapter 8 Quadrilaterals Exercise 8.2 step by step?

You can download free PDF of NCERT Solutions for Class 9 Maths Chapter 8 Quadrilaterals Exercise 8.2 from the official NCERT website and various educational platforms offering CBSE resources. These step by step solutions are prepared as per the latest CBSE syllabus 2025-26 and include detailed explanations for all 6 questions. The PDF format allows offline access for convenient exam preparation.

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

Quadrilaterals Chapter 8 carries approximately 5 marks in CBSE Class 9 Maths board exam 2025-26 as part of Unit IV - Geometry. Exercise 8.2 focusing on Mid-point Theorem is crucial as questions from this topic frequently appear in board examinations. The weightage is shared with other geometry chapters, making thorough practice of NCERT Solutions essential.

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Q4. Which is the most difficult question in NCERT Solutions Exercise 8.2 of Class 9 Maths Chapter 8 Quadrilaterals?

Question 6 in NCERT Solutions Class 9 Maths Chapter 8 Quadrilaterals Exercise 8.2 is generally considered the most challenging by students. This question involves application of the Mid-point Theorem combined with properties of parallelograms requiring multi-step reasoning. However, with step by step solutions and proper understanding of concepts, all questions become manageable for CBSE board exam 2025-26 preparation.

Q5. What is Mid-point Theorem in NCERT Class 9 Maths Chapter 8 Quadrilaterals Exercise 8.2?

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. Exercise 8.2 of Quadrilaterals chapter specifically focuses on applications of this theorem to prove various properties. Understanding this concept is crucial for solving all 6 questions in Exercise 8.2 and for CBSE board exam 2025-26.

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