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SOLUTIONS: CHAPTER TEST - QUADRILATERALS (HOTS)

Mathematics | Class IX | (2026/QUAD-HOTS/09/001)

Section A: Multiple Choice Questions

1. **Answer: (a) Isosceles Trapezium**

A trapezium where the non-parallel sides are equal is specifically known as an isosceles trapezium.

2. **Answer: (c) Square**

Diagonals equal \implies Rectangle. Diagonals bisect at $90^\circ \implies$ Rhombus. A figure that is both a rectangle and a rhombus is a square.

3. **Answer: (c) Diagonals of PQRS are perpendicular**

The sides of the mid-point quadrilateral are parallel to the diagonals. If diagonals are perpendicular, the adjacent sides of the mid-point quadrilateral will meet at 90° .

4. **Answer: (b) 12 cm**

By Mid-point theorem, each side of $\triangle DEF$ is half of the corresponding side of $\triangle ABC$. Perimeter of $\triangle DEF = \frac{1}{2} \times 24 = 12$ cm.

5. **Answer: (c) 50°**

Diagonal and side form a triangle with the other diagonal. In a rectangle, diagonals bisect and are equal, forming isosceles triangles. The base angles are 25° . The angle at the center is $180 - (25 + 25) = 130^\circ$. The acute angle is $180 - 130 = 50^\circ$.

6. **Answer: (b) 90°**

Adjacent angles sum to 180° . $\frac{1}{2}\angle A + \frac{1}{2}\angle B = \frac{1}{2}(180) = 90^\circ$. In $\triangle AOB$, $\angle AOB = 180 - 90 = 90^\circ$.

7. **Answer: (a) 24 cm**

Diagonals bisect at 90° . Let half diagonals be 5 and x . $5^2 + x^2 = 13^2 \implies x = 12$. Full diagonal = $2 \times 12 = 24$ cm.

8. **Answer: (c) 50°**

In rhombus $ABCD$, $AB = BC \implies \angle BAC = \angle ACB = 40^\circ$. In $\triangle ABC$, $\angle B = 180 - 80 = 100^\circ$. Opposite $\angle D = 100^\circ$. Diagonals bisect angles, so $\angle ADB = 100/2 = 50^\circ$.

Section B: Short Answer Questions

1. **Mid-point Theorem Proof:**

In $\triangle ABC$, let D, E be mid-points of AB, AC . Extend DE to F such that $DE = EF$ and join CF . By SAS, $\triangle ADE \cong \triangle CFE$. Thus $AD = CF$ and $\angle ADE = \angle CFE$. Since $AD = BD$, $CF = BD$ and $CF \parallel BD$. Thus $BCFD$ is a parallelogram, so $DF \parallel BC \implies DE \parallel BC$.

2. In parallelogram $ABCD$: $\angle A = \angle C \implies 3x - 20 = 100 \implies 3x = 120 \implies x = 40$.

$\angle A + \angle B = 180^\circ \implies 100 + y + 15 = 180 \implies y + 115 = 180 \implies y = 65$.

3. In $\triangle AOB$ and $\triangle COD$ (where O is intersection of diagonals): $AO = CO, BO = DO$ (Given), $\angle AOB = \angle COD$ (V.O.A). By SAS, $\triangle AOB \cong \triangle COD \implies AB = CD$ and

$\angle OAB = \angle OCD$. Alternate angles equal $\implies AB \parallel CD$. One pair equal and parallel \implies Parallelogram.

4. In quadrilateral $ABCD$:

Interior $\angle A = 180 - x$ and Interior $\angle C = 180 - y$.

Sum of angles = $(180 - x) + a + (180 - y) + b = 360^\circ$.

$360 - x - y + a + b = 360 \implies x + y = a + b$.

Section C: Short Answer Questions

1. Let $ABCD$ be a rhombus. Its diagonals $AC \perp BD$. The sides of the mid-point quadrilateral $PQRS$ are parallel to the diagonals (Mid-point theorem). Since $AC \parallel PQ$ and $BD \parallel QR$, and $AC \perp BD$, it follows $PQ \perp QR$. A parallelogram with one right angle is a rectangle.
2. E, F mid-points of $AB, CD \implies AE = FC$ and $AE \parallel FC \implies AECF$ is a parallelogram. In $\triangle ABP$, E is mid-point and $EQ \parallel AP \implies Q$ is mid-point of BP . Similarly in $\triangle DQC$, P is mid-point of DQ . Thus $DP = PQ = QB$, meaning BD is trisected.
3. In trapezium $ABCD$ with $AD = BC$: By mid-point theorem, $PQ = \frac{1}{2}AC$ and $SR = \frac{1}{2}AC$. Also $QR = \frac{1}{2}BD$ and $PS = \frac{1}{2}BD$. In an isosceles trapezium, diagonals $AC = BD$. Therefore, $PQ = QR = RS = SP$. A quadrilateral with all sides equal is a rhombus.

Section D: Long Answer Questions

1. (i) In $\triangle ABC$, M is mid-point of AB and $MD \parallel BC$. By converse of mid-point theorem, D is mid-point of AC .
(ii) Since $MD \parallel BC$ and AC is transversal, $\angle ADM = \angle ACB$ (Corresponding). $\angle ACB = 90^\circ \implies \angle ADM = 90^\circ \implies MD \perp AC$.
(iii) In $\triangle ADM$ and $\triangle CDM$: $AD = CD$ (D is mid-point), $MD = MD$ (Common), $\angle ADM = \angle CDM = 90^\circ$. By SAS, $\triangle ADM \cong \triangle CDM \implies MA = MC$. Since M is mid-point of AB , $MA = \frac{1}{2}AB$. Hence $CM = MA = \frac{1}{2}AB$.
2. In $\triangle ALO$ and $\triangle CMO$ (O is intersection of LM and BD):
 $AL = MC$ (Given), $\angle LAO = \angle MCO$ (Alt. angles as $AB \parallel DC$), $\angle ALO = \angle CMO$ (Alt. angles). By ASA, $\triangle ALO \cong \triangle CMO$. Thus $AO = CO$ and $LO = MO$. This implies LM and AC bisect each other. Since O also lies on diagonal BD and diagonals of parallelogram bisect each other, LM and BD bisect each other.
3. (i) $\angle ADC = 90^\circ$ (Square), $\angle EDC = 60^\circ$ (Equilateral). $\angle ADE = 90 + 60 = 150^\circ$. In $\triangle ADE$, $AD = DE$ (since $AD = DC = DE$). Base angles $\angle AED = \angle DAE = (180 - 150)/2 = 15^\circ$.
(ii) Similarly, $\angle BEC = 15^\circ$. $\angle AEB = \angle CED - (\angle AED + \angle BEC) = 60 - (15 + 15) = 30^\circ$.
(iii) Reflex $\angle AEB = 360 - 30 = 330^\circ$.