

WA8MMGTW4

Two-dimensional space and structures

Core + Challenge

# Properties of Quadrilaterals — Marking Key

I can classify quadrilaterals by their sides, angles, diagonals and symmetry, and use properties to find unknowns.

*For tutors and parents. Award method marks for correct working even if the final answer is wrong.*

## Marks summary

Section A Fluency: 16   Section B Core: 23   Section C Reasoning: 9   Section D Challenge: 11   **Total: 59**

Fluency: 1 mark each; accept an equivalent unsimplified answer for half credit at tutor's discretion.

**A**

**Fluency** *answers and working*

/ 16 marks

| Q  | Answer        | Working                                               |
|----|---------------|-------------------------------------------------------|
| 1  | parallelogram | two pairs of parallel sides                           |
| 2  | rhombus       | four equal sides                                      |
| 3  | rectangle     | four right angles                                     |
| 4  | square        | equal sides and right angles                          |
| 5  | kite          | two pairs of equal adjacent sides                     |
| 6  | trapezium     | one pair of parallel sides                            |
| 7  | 1             | along the main diagonal                               |
| 8  | 2             | along both diagonals                                  |
| 9  | 4             | 2 diagonals + 2 through midpoints                     |
| 10 | 0             | a parallelogram has none (it has rotational symmetry) |
| 11 | 2             | looks the same after 180°                             |
| 12 | rhombus       | a square would have right angles                      |
| 13 | rectangle     | all four angles become 90°                            |
| 14 | yes           | it has four equal sides                               |
| 15 | no            | its sides need not be equal                           |
| 16 | square        | equal → rectangle; perpendicular → rhombus            |

**B**

**Core** *answers, working and marks*

/ 23 marks

| Q | Answer                                          | Working / sample response                                                                                                                                                                                                                                                                                                 | Marks |
|---|-------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1 | 115°, 65°, 115°; 22 cm                          | <p>Co-interior angles: angle ABC = <math>180^\circ - 65^\circ = 115^\circ</math><br/> Opposite angles equal: angle BCD = <math>65^\circ</math>, angle CDA = <math>115^\circ</math><br/> <math>P = 2 \times (7 + 4) = 22</math> cm<br/> <i>1 mark: 115°</i><br/> <i>1 mark: other angles</i><br/> <i>1 mark: 22 cm</i></p> | 3     |
| 2 | 90°, 55°, 70°                                   | <p>Diagonals of a rhombus are perpendicular: angle AOB = <math>90^\circ</math><br/> Triangle AOB: <math>180^\circ - 90^\circ - 35^\circ = 55^\circ</math><br/> AC bisects angle DAB: <math>2 \times 35^\circ = 70^\circ</math><br/> <i>1 mark each with reason</i></p>                                                    | 3     |
| 3 | QS = 18 cm; PM = 9 cm                           | <p>Diagonals of a rectangle are equal and bisect each other: <math>18 \div 2 = 9</math><br/> <i>1 mark each</i></p>                                                                                                                                                                                                       | 2     |
| 4 | x = 115°                                        | <p>The angles between unequal sides are equal (symmetry)<br/> <math>x = (360^\circ - 80^\circ - 50^\circ) \div 2 = 115^\circ</math><br/> <i>1 mark: equal angles</i><br/> <i>1 mark: 115°</i></p>                                                                                                                         | 2     |
| 5 | Rhombus                                         | <p>Bisecting diagonals → parallelogram; perpendicular → rhombus<br/> Unequal diagonals → not a square<br/> <i>1 mark: rhombus</i><br/> <i>1 mark: reason</i></p>                                                                                                                                                          | 2     |
| 6 | x = 5                                           | <p>Opposite sides are equal: <math>3x + 2 = 17</math><br/> <math>3x = 15</math>, so <math>x = 5</math><br/> <i>1 mark: equation</i><br/> <i>1 mark: 5</i></p>                                                                                                                                                             | 2     |
| 7 | 10 cm                                           | <p>Side = <math>52 \div 4 = 13</math> cm<br/> Diagonals bisect at <math>90^\circ</math>: half-diagonal = <math>\sqrt{(13^2 - 12^2)} = \sqrt{25} = 5</math><br/> Other diagonal = <math>2 \times 5 = 10</math> cm<br/> <i>1 mark: 13</i><br/> <i>1 mark: 5</i><br/> <i>1 mark: 10 cm</i></p>                               | 3     |
| 8 | (a) rectangle, square (b) rhombus, square, kite | <p>Check each property in the key idea<br/> <i>1 mark each</i></p>                                                                                                                                                                                                                                                        | 2     |
| 9 | Parallelogram                                   | <p>AB and DC are both 4 units across (parallel and equal)<br/> AD and BC both go 1 right and 3 up. No right angles, and <math>AD \neq AB</math>, so not a rectangle or rhombus<br/> <i>1 mark: parallelogram</i><br/> <i>1 mark: reason</i></p>                                                                           | 2     |

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| Q  | Answer          | Working / sample response                                                                                                                           | Marks |
|----|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 10 | 70°, 110°, 110° | Symmetry: angle ABC = 70°<br>Co-interior angles: $180^\circ - 70^\circ = 110^\circ$ at C and at D<br><i>1 mark: 70°</i><br><i>1 mark: both 110°</i> | 2     |

C

Reasoning *sample answers and marking criteria*

/ 9 marks

| Q | Answer                                      | Working / sample response                                                                                                                                                                                      | Marks |
|---|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1 | A square has all the rectangle's properties | A square has four right angles and opposite sides parallel, so it is a rectangle<br>A rectangle need not have four equal sides<br><i>1 mark each part</i>                                                      | 2     |
| 2 | True                                        | A kite needs two pairs of equal adjacent sides<br>In a rhombus all four sides are equal, so both pairs of adjacent sides are equal<br><i>1 mark: true</i><br><i>1 mark: reason</i>                             | 2     |
| 3 | False                                       | e.g. a rhombus with angles 60° and 120°: its diagonals are clearly different lengths<br>Only rectangles (including squares) have equal diagonals<br><i>1 mark: counterexample</i><br><i>1 mark: rectangles</i> | 2     |
| 4 | Both are supplementary to angle B           | AD is parallel to BC: angle A + angle B = 180°<br>AB is parallel to DC: angle B + angle C = 180°<br>So angle A = 180° – angle B = angle C<br><i>1 mark each step</i>                                           | 3     |

D

Challenge *solutions and marking criteria*

/ 11 marks

| Q | Answer                                | Working / sample response                                                                                                                                                                                                                                                                                 | Marks |
|---|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1 | $x = 30^\circ$ ; 60°, 120°, 60°, 120° | Angle AOB = 90° (diagonals perpendicular), so $x + 2x = 90^\circ$ and $x = 30^\circ$<br>Diagonals bisect the angles: angle DAB = 60°, angle ABC = 120°<br>Opposite angles equal: 60°, 120°, 60°, 120°<br><i>1 mark: 90°</i><br><i>1 mark: <math>x = 30^\circ</math></i><br><i>1 mark: all four angles</i> | 3     |
| 2 | 65°; 25°                              | MA = MB (the diagonals are equal and bisect each other), so triangle AMB is isosceles<br>Angle MAB = $(180^\circ - 50^\circ) \div 2 = 65^\circ$ = angle MBA<br>Angle MBC = $90^\circ - 65^\circ = 25^\circ$<br><i>1 mark: isosceles</i><br><i>1 mark: 65°</i><br><i>1 mark: 25°</i>                       | 3     |

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| Q | Answer                                               | Working / sample response                                                                                                                                                                                                                                                                                                                                                                                 | Marks |
|---|------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 3 | (3, 4), (13, 4), (-3, -4);<br>(3, 4) gives a rhombus | <p>Opposite sides are equal vectors: <math>P + R - Q = (3, 4)</math>, <math>Q + R - P = (13, 4)</math>, <math>P + Q - R = (-3, -4)</math></p> <p><math>PQ = 5</math> and <math>QR = \sqrt{3^2 + 4^2} = 5</math></p> <p>So PQRS with <math>S(3, 4)</math> has four sides of 5: a rhombus</p> <p><i>1 mark: two positions</i></p> <p><i>1 mark: all three</i></p> <p><i>1 mark: rhombus with reason</i></p> | 3     |
| 4 | 66 cm                                                | <p>AC bisects BD at right angles: <math>BO = 12</math></p> <p><math>AB = \sqrt{25 + 144} = 13</math>; <math>CB = \sqrt{256 + 144} = 20</math></p> <p><math>P = 2 \times (13 + 20) = 66</math> cm</p> <p><i>1 mark: 13 and 20</i></p> <p><i>1 mark: 66 cm</i></p>                                                                                                                                          | 2     |