GRADE 8

Quadrilaterals & Polygons

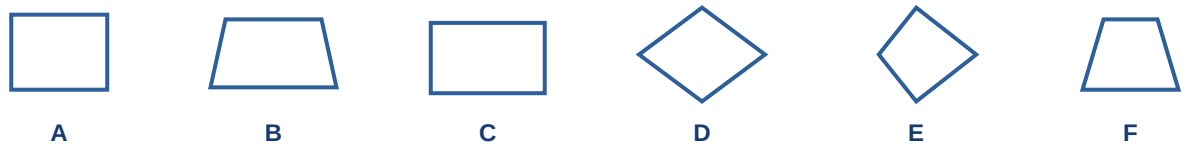
Properties • Angle reasoning • Regular polygons • Diagonals • Symmetry • Coordinates

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Includes corrected calculations, consistent measurements and clearer instructions.

Show your working. Use correct geometric vocabulary and include units where appropriate.

1. Quadrilateral Properties

Show your working and use correct geometric vocabulary. Include units where appropriate.



The six outline diagrams are labelled A–F. Use their visible side and angle properties to classify them.

1. Classify each shape A–F in the diagram as a square, rectangle, parallelogram, rhombus, kite or trapezium. Give one defining property for each.

2. A parallelogram has one angle of 68°. Find all four interior angles.

3. A rectangle is 14 cm by 9 cm. Find its perimeter and area. Explain why every rectangle is a parallelogram.

4. A rhombus has diagonals 14 cm and 18 cm. Find its area and perimeter. Give the perimeter to 1 decimal place.

5. A quadrilateral has angles 82°, 97°, 104° and x°. Find x.

6. Is the statement “A square is both a rhombus and a rectangle” always true, sometimes true or never true? Explain.

Answer Key — 1. Quadrilateral Properties

Equivalent correct methods are acceptable. Explanations should use appropriate mathematical vocabulary.

1. A: square (four equal sides and four right angles). B: parallelogram (both pairs of opposite sides parallel). C: rectangle (four right angles). D: rhombus (four equal sides). E: kite (two pairs of adjacent equal sides). F: trapezium (one pair of parallel sides).

2. Opposite angles are equal and adjacent angles are supplementary: 68°, 112°, 68°, 112°.

3. Perimeter = $2(14 + 9) = 46$ cm. Area = $14 \times 9 = 126$ cm². A rectangle has two pairs of opposite sides parallel.

4. Area = $\frac{1}{2} \times 14 \times 18 = 126$ cm². Each side = $\sqrt{(7^2 + 9^2)} = \sqrt{130}$ cm. Perimeter = $4\sqrt{130} \approx 45.6$ cm.

5. $x = 360° - (82° + 97° + 104°) = 77°$.

6. Always true. A square has four equal sides and four right angles, so it meets the definitions of both a rhombus and a rectangle.

2. Angles in Quadrilaterals & Polygons

Show your working and use correct geometric vocabulary. Include units where appropriate.

1. Find the missing angle in a quadrilateral with angles 73°, 91°, 112° and x°.

2. The angles of a quadrilateral are x°, (x + 20)°, (2x + 10)° and (x – 5)°. Find x and all four angles.

3. A regular polygon has each interior angle equal to 135°. How many sides does it have?

4. The exterior angle of a regular polygon is 24°. Find the number of sides and each interior angle.

5. A pentagon has interior angles 105°, 118°, 132°, 97° and x°. Find x.

6. A regular polygon has 12 sides. Find its interior-angle sum, each interior angle and each exterior angle.

Answer Key — 2. Angles in Quadrilaterals & Polygons

Equivalent correct methods are acceptable. Explanations should use appropriate mathematical vocabulary.

1. $x = 360° – (73° + 91° + 112°) = 84°$.

2. $5x + 25 = 360$, so $x = 67°$. The angles are 67°, 87°, 144° and 62°.

3. Exterior angle = 180° – 135° = 45°. Number of sides = 360° ÷ 45° = 8.

4. Number of sides = 360° ÷ 24° = 15. Each interior angle = 180° – 24° = 156°.

5. $x = 540° – (105° + 118° + 132° + 97°) = 88°$.

6. Interior-angle sum = (12 – 2) × 180° = 1800°. Each interior angle = 1800° ÷ 12 = 150°. Each exterior angle = 360° ÷ 12 = 30°.

3. Regular & Irregular Polygons

Show your working and use correct geometric vocabulary. Include units where appropriate.

1. Complete for regular 5-, 6-, 8- and 10-gons: interior-angle sum, each interior angle and each exterior angle.

2. A regular polygon has 15 sides. Find each exterior and interior angle.

3. Explain the difference between a regular and an irregular polygon. Give one example of each.

4. A regular polygon has each interior angle 156°. Find its number of sides.

5. A regular polygon has an exterior angle of 18°. Find its number of sides.

6. A 9-gon has interior angles of 135° each. Can it be regular? Prove your answer.

Answer Key — 3. Regular & Irregular Polygons

Equivalent correct methods are acceptable. Explanations should use appropriate mathematical vocabulary.

1. 5-gon: sum 540°, interior 108°, exterior 72°. 6-gon: sum 720°, interior 120°, exterior 60°. 8-gon: sum 1080°, interior 135°, exterior 45°. 10-gon: sum 1440°, interior 144°, exterior 36°.

2. Each exterior angle = 360° ÷ 15 = 24°. Each interior angle = 180° – 24° = 156°.

3. A regular polygon has all sides equal and all interior angles equal (for example, a square). An irregular polygon does not have all sides and angles equal (for example, a non-square rectangle).

4. Exterior angle = 180° – 156° = 24°. Number of sides = 360° ÷ 24° = 15.

5. Number of sides = 360° ÷ 18° = 20.

6. No. A regular 9-gon has each interior angle [(9 – 2) × 180°] ÷ 9 = 140°, not 135°.

4. Diagonals, Symmetry & Shape Reasoning

Show your working and use correct geometric vocabulary. Include units where appropriate.

1. How many diagonals can be drawn from one vertex of a decagon? State the formula.

2. Find the total number of diagonals in a decagon.

3. A polygon has 35 diagonals. How many sides does it have?

4. A regular hexagon has what order of rotational symmetry and how many lines of symmetry?

5. A rectangle that is not a square has how many lines of symmetry and what order of rotational symmetry?

6. Describe a quadrilateral with exactly one line of symmetry. Then name one with two lines of symmetry.

Answer Key — 4. Diagonals, Symmetry & Shape Reasoning

Equivalent correct methods are acceptable. Explanations should use appropriate mathematical vocabulary.

1. $n - 3 = 10 - 3 = 7$ diagonals.

2. $n(n - 3)/2 = 10 \times 7 \div 2 = 35$ diagonals.

3. $n(n - 3)/2 = 35$, so $n(n - 3) = 70$. $n = 10$ sides.

4. Rotational symmetry order 6; six lines of symmetry.

5. Two lines of symmetry; rotational symmetry order 2.

6. A kite (that is not a rhombus) can have exactly one line of symmetry. A non-square rectangle has two lines of symmetry.

5. Coordinate & Composite Polygon Challenges

Show your working and use correct geometric vocabulary. Include units where appropriate.

1. Plot A(1,1), B(7,1), C(7,4), D(1,4). Identify the quadrilateral and find its area and perimeter.

2. A(0,0), B(6,0), C(6,3), D(4,5), E(0,5) form a pentagon. Find its area by splitting it into simpler shapes.

3. A regular hexagon has side length 8 cm. Find its perimeter. If its apothem is 6.9 cm, estimate its area using A = ½ × perimeter × apothem.

4. A 6 cm × 4 cm rectangle is joined to a 4 cm × 4 cm square along one complete 4 cm side. Find the outside perimeter and total area.

5. Points (–2,1), (4,1), (5,5), (–1,5) form a quadrilateral. Determine whether both pairs of opposite sides are parallel.

6. Choose five different interior angles for a convex pentagon and verify that their sum is 540°.

Answer Key — 5. Coordinate & Composite Polygon Challenges

Equivalent correct methods are acceptable. Explanations should use appropriate mathematical vocabulary.

1. Rectangle; length 6 units and width 3 units. Area = 18 square units; perimeter = 18 units.

2. Area = $6 \times 5 - \frac{1}{2} \times 2 \times 2 = 30 - 2 = 28$ square units.

3. Perimeter = $6 \times 8 = 48$ cm. Area $\approx \frac{1}{2} \times 48 \times 6.9 = 165.6$ cm².

4. The joined shape is a 10 cm × 4 cm rectangle. Total area = 24 + 16 = 40 cm². Outside perimeter = 2(10 + 4) = 28 cm.

5. Yes. Both pairs of opposite sides are parallel, so the quadrilateral is a parallelogram.

6. Answers vary. Any five different interior angles of a convex pentagon that total 540° are acceptable (for example, 90°, 100°, 110°, 115° and 125°).

6. Quadrilaterals & Polygons — Challenge

Show your working and use correct geometric vocabulary. Include units where appropriate.

Use the angle-sum, diagonal and exterior-angle properties you have learned.

1. The angles of a quadrilateral are in the ratio 2:3:4:6. Find all four angles.

2. A regular polygon has 20 sides. Find its interior-angle sum and each interior angle.

3. A polygon has an interior-angle sum of 1440°. How many sides does it have?

4. A regular polygon has each interior angle 150°. A second regular polygon has twice as many sides. Find the second polygon’s number of sides and each interior angle.

5. A quadrilateral has diagonals that bisect each other at right angles. Name a family that fits, and explain why the information may not identify one unique shape.

6. Explain why the sum of one exterior angle at each vertex of any convex polygon is 360°.

Answer Key — 6. Quadrilaterals & Polygons — Challenge

Equivalent correct methods are acceptable. Explanations should use appropriate mathematical vocabulary.

1. Total ratio parts = 15; each part = 360° ÷ 15 = 24°. Angles: 48°, 72°, 96° and 144°.

2. Interior-angle sum = (20 – 2) × 180° = 3240°. Each interior angle = 3240° ÷ 20 = 162°.

3. (n – 2) × 180° = 1440°, so n – 2 = 8 and n = 10 sides.

4. First polygon: exterior angle = 30°, so it has 12 sides. Second polygon has 24 sides. Each exterior angle = 360° ÷ 24 = 15°, so each interior angle = 165°.

5. A rhombus fits because its diagonals bisect each other at right angles. A square also fits, so the information does not identify one unique quadrilateral.

6. The exterior angles represent one complete turn as you move around the convex polygon. One complete turn is 360°.