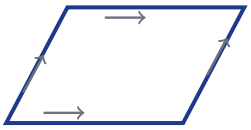
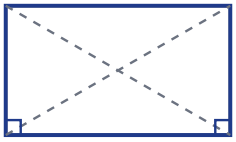
Properties of Quadrilaterals

Name: _____	Date: _____	Score: _____ / 17

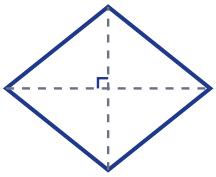
A **quadrilateral** is any four-sided polygon, and here is the first fact to remember: its interior angles always add to $360°$. Special quadrilaterals—parallelograms, rectangles, rhombuses, squares, and trapezoids—each come with their own bonus properties involving parallel sides, equal sides, equal angles, or diagonal tricks. They even form a family tree: every square is also a rectangle *and* a rhombus, and every rectangle is also a parallelogram! Knowing each shape's properties helps you identify figures, find missing measurements, and solve real-world design problems.



Parallelogram
opp. sides parallel

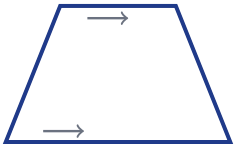


Rectangle
4 right angles

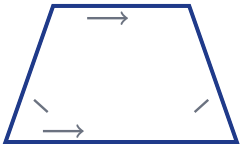


Rhombus
4 equal sides

Square
rectangle + rhombus



Trapezoid
1 pair of parallel sides



Isosceles trapezoid
equal legs

Key Concepts & Quick Review

Sum of interior angles of any quadrilateral: $360°$.

Shape	Key Properties
Parallelogram	Opposite sides parallel & equal; opposite angles equal
Rectangle	Parallelogram with four $90°$ angles
Rhombus	Parallelogram with four equal sides
Square	Rectangle *and* rhombus (four equal sides, four $90°$ angles)
Trapezoid	Exactly one pair of parallel sides (called bases)
Isosceles trapezoid	Trapezoid with equal non-parallel sides (legs)

Diagonals: In a rectangle, diagonals are equal. In a rhombus, diagonals bisect each other at right angles. A square has both properties.

Examples

① A parallelogram has angles of $70°$ and $110°$. What are the other two angles?

Think It Through: In a parallelogram, opposite angles are always equal and consecutive angles are supplementary (add to $180°$). Since one angle is $70°$, the angle across from it is also $70°$. The two angles next to it must each be $180° - 70° = 110°$. Quick check: $70 + 110 + 70 + 110 = 360°$—perfect! ✓

Answer: $70°$ *and* $110°$

② Three angles of a quadrilateral are $95°$, $85°$, and $100°$. Find the fourth angle.

Think It Through: Remember, the four angles of any quadrilateral always add up to $360°$. Add the three you know first: $95 + 85 + 100 = 280°$. Then subtract from the total: $360° - 280° = 80°$. So the missing angle is $80°$.

Answer: $80°$

Practice Problems

Find the missing angle(s) or identify the quadrilateral.

1. Quadrilateral angles: $90°$, $90°$, $90°$, x. Find the fourth angle x. _____
2. Quadrilateral angles: $60°$, $120°$, $60°$, x. Find the fourth angle x. _____
3. Quadrilateral angles: $80°$, $100°$, $80°$, x. Find the fourth angle x. _____
4. Quadrilateral angles: $75°$, $105°$, $75°$, x. Find the fourth angle x. _____
5. Quadrilateral angles: $110°$, $70°$, $110°$, x. Find the fourth angle x. _____
6. Quadrilateral angles: $85°$, $95°$, $100°$, x. Find the fourth angle x. _____
7. Quadrilateral angles: $45°$, $135°$, $45°$, x. Find the fourth angle x. _____
8. Quadrilateral angles: $90°$, $90°$, $120°$, x. Find the fourth angle x. _____
9. Quadrilateral angles: $55°$, $125°$, $55°$, x. Find the fourth angle x. _____
10. Quadrilateral angles: $130°$, $50°$, $130°$, x. Find the fourth angle x. _____
11. In a parallelogram, $\angle A = 65°$. Find the adjacent angle $\angle B$. _____
12. In a rhombus, $\angle P = 72°$. Find the adjacent angle $\angle Q$. _____
13. Identify the quadrilateral with all sides equal and all angles $90°$. _____
14. Identify the quadrilateral with exactly one pair of parallel sides. _____
15. Identify the quadrilateral with opposite sides parallel and equal but no right angles. _____

Study Tips

- **Every square is a rectangle and a rhombus**, but not every rectangle or rhombus is a square. Think of the hierarchy!
- If all four angles must total $360°$ and you know three, the fourth is simply $360°$ minus the sum of the other three.
- Sketch and label the figure. Mark equal sides with tick marks and parallel sides with arrows to visualise the properties.

Word Problems

16. A picture frame is a parallelogram. One angle measures $65°$. What are the measures of the other three angles? _____

17. A park is shaped like a trapezoid. The two base angles on the longer side each measure $70°$. Find the measures of the other two angles. _____

Answer Keys

1) $90°$
2) $120°$
3) $100°$
4) $105°$
5) $70°$
6) $80°$
7) $135°$
8) $60°$
9) $125°$
10) $50°$
11) $115°$
12) $108°$
13) square
14) trapezoid
15) parallelogram
16) $115°$, $65°$, and $115°$.
17) Each is $110°$.

Step-by-Step Explanations

Strategy: For Rewriting Expressions to Solve Problems, choose an equivalent form that makes the situation easier to evaluate or compare. The useful form is the one that reveals the pattern the word problem is hiding.

Practice 1: Rearrange the formula $A = lw$ to solve for w. **Answer:** $w = \frac{A}{l}$
In the opening example, rearrange the area formula by dividing both sides by the length.

Practice 15: Simplify the expression $\frac{4x+8}{2}$. **Answer:** $2x + 4$
For the end-of-set item, distribute first, then combine matching terms into one simplified expression.

Word-problem notes:

16. Answer: $C = \frac{5}{9}(F - 32)$; $68°\text{F} = 20°\text{C}$; freeze: $32°\text{F}$; boil: $212°\text{F}$.
Start with $F = \frac{9}{5}C + 32$. Subtract 32 from both sides to get $F - 32 = \frac{9}{5}C$. Then multiply both sides by $\frac{5}{9}$, which gives $C = \frac{5}{9}(F - 32)$. For $68°$F, substitute and compute: $C = \frac{5}{9}(68 - 32) = \frac{5}{9}(36) = 20°$C. To check the freeze and boil points, plug $0°$C and $100°$C into the original Fahrenheit formula, giving $32°$F and $212°$F.

17. Answer: $t = \frac{d}{s}$; $60\,km$: $2.5\,hr = 2\,hr\ 30\,min$; $90\,km$: $3.75\,hr = 3\,hr\ 45\,min$.
Start with $s = \frac{d}{t}$. Multiply both sides by t to get $st = d$, then divide by s to isolate time: $t = \frac{d}{s}$. For $60\,km$ at $24\,km$/h, $t = \frac{60}{24} = 2.5$ hours, which is 2 hours $30\,min$. For $90\,km$, $t = \frac{90}{24} = 3.75$ hours, which is 3 hours $45\,min$. The formula shows that time gets larger when distance gets larger if the speed stays the same.

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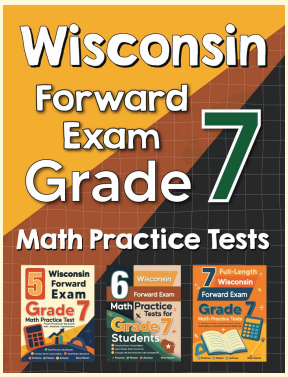

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