

Check Your Understanding 5.2

Show all work. Write CPCTC in full before using it. For proofs: flowchart or paragraph form only.

Basic	Intermediate	Advanced
Row 1 Spiral — Classification and Definitions → Organizing the family		
<i>Basic — Spiral</i> 1. Name every quadrilateral type that must have diagonals that bisect each other. 2. A quadrilateral has two pairs of parallel sides. Name all types it could be.	<i>Intermediate — Spiral</i> 3. True or false? If false, give a counterexample and correct the statement. (a) Every rhombus is a rectangle. (b) Every square is a rhombus. (c) A quadrilateral with perpendicular diagonals must be a square.	<i>Advanced — Spiral</i> 4. A student proves that parallelograms have diagonals that bisect each other. They then claim this means rectangles also have bisecting diagonals, and so do rhombi and squares — without doing any extra work. Is the student right? Explain using the hierarchy and conditional logic.
Parallelogram Properties → Proving the engine		
<i>Basic</i> 5. In parallelogram PQRS, $\angle P = 74^\circ$. Find $\angle Q$, $\angle R$, and $\angle S$. 6. In parallelogram ABCD, $AB = 12$ and $BC = 7$. Find CD and AD. 7. In parallelogram WXYZ, the diagonals intersect at M. If $WM = 9$, find MY. 8. State all four parallelogram properties as conditional statements.	<i>Intermediate</i> 9. In parallelogram ABCD, $\angle A = (4x + 6)^\circ$ and $\angle C = (6x - 14)^\circ$. Find x and all four angles. 10. In parallelogram EFGH, diagonal $EG = 18$. The diagonals intersect at P. $FP = 3y - 2$ and $PH = y + 6$. Find y and FH. 11. A quadrilateral has vertices A(0, 0), B(5, 0), C(7, 3), D(2, 3). Use slope to determine whether it is a parallelogram.	<i>Advanced</i> 12. Prove that the diagonals of a parallelogram bisect each other. Write a complete paragraph or flowchart proof. State every step and cite every reason. 13. Prove the converse: if both pairs of opposite sides of a quadrilateral are congruent, then it is a parallelogram.
Algebra Spiral Expand	<i>Algebra Spiral</i> Expand each expression completely. (a) $(x + 6)(x - 2)$ (b) $(4a - 3)^2$ (c) $(2y - 5)(3y + 1)$	

Answers — CYU 5.2**Row 1 Spiral**

1. Parallelogram, rectangle, rhombus, square.
2. Parallelogram, rectangle, rhombus, square.
- 3a. False — a rhombus with non-right angles is not a rectangle.
- 3b. True.
- 3c. False — a kite also has perpendicular diagonals.
4. Yes. Rectangle $\subset$ parallelogram, rhombus $\subset$ parallelogram, square $\subset$ parallelogram. Any property proven for all parallelograms transfers automatically to all subsets.

Parallelogram Properties

5. $\angle Q = 106^\circ$, $\angle R = 74^\circ$, $\angle S = 106^\circ$.
6. $CD = 12$, $AD = 7$.
7. $MY = 9$.
8. (1) Opposite sides congruent. (2) Opposite angles congruent. (3) Consecutive angles supplementary. (4) Diagonals bisect each other.
9. $x = 10$. $\angle A = \angle C = 46^\circ$. $\angle B = \angle D = 134^\circ$.
10. $y = 4$. $FP = PH = 10$. $FH = 20$.
11. Slope $AB = 0$, Slope $DC = 0 \rightarrow AB \parallel DC$. Slope $BC = 3/2$, Slope $AD = 3/2 \rightarrow BC \parallel AD$. Parallelogram.
12. $AB \parallel DC \rightarrow \angle ABE = \angle CDE$ (alt. int.). $BC \parallel AD \rightarrow \angle BAE = \angle DCE$ (alt. int.). $AB = DC$ (Property 1). $\triangle ABE \cong \triangle CDE$ (ASA). $AE = CE$ and $BE = DE$ (CPCTC). ■
13. $AB = CD$, $BC = AD$ (given). $AC = AC$ (reflexive). $\triangle ABC \cong \triangle CDA$ (SSS). $\angle BAC = \angle DCA$ (CPCTC) $\rightarrow AB \parallel DC$. $\angle BCA = \angle DAC$ (CPCTC) $\rightarrow BC \parallel AD$. Parallelogram. ■

Algebra Spiral

- (a) $x^2 + 4x - 12$
- (b) $16a^2 - 24a + 9$
- (c) $6y^2 - 13y - 5$