

Proving Quadrilaterals in the Coordinate Plane

Mathematical Goals

- Prove theorems pertaining to lines and angles.
- Prove theorems pertaining to triangles.
- Prove theorems pertaining to parallelograms.

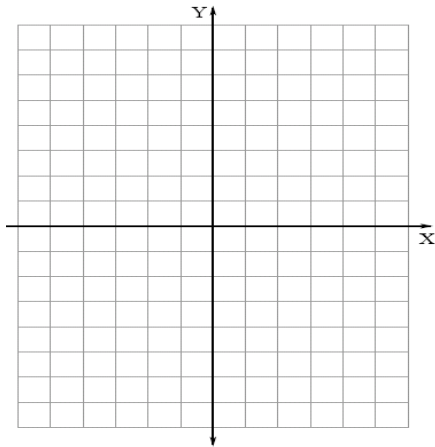
STANDARDS ADDRESSED IN THIS TASK

MCC9-12.G.CO.11 Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.

Standards for Mathematical Practice

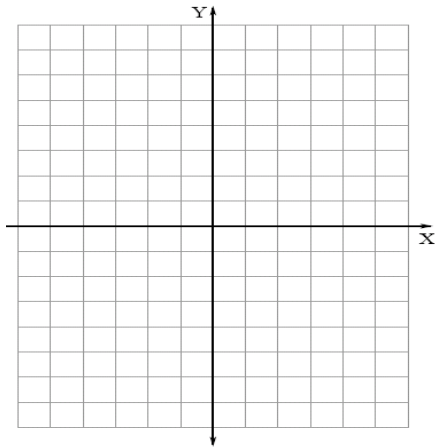
- 1. Make sense of problems and persevere in solving them** by requiring students to interpret and make meaning of a problem and find a logical starting point, and to monitor their progress and change their approach to solving the problem, if necessary.
- 2. Reason abstractly and quantitatively** by requiring students to make sense of quantities and their relationships to one another in problem situations.
- 3. Construct viable arguments and critique the reasoning of others** by engaging students on discussion of why they agree or disagree with responses, decide whether they make sense, and ask useful questions to clarify or improve the arguments.
- 4. Model with mathematics** by expecting students to apply the mathematics concepts they know in order to solve problems arising in everyday situations, and reflect on whether the results are sensible for the given scenario.
- 5. Use appropriate tools strategically** by expecting students to consider available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a compass, a calculator, software, etc.
- 6. Attend to precision** by requiring students to calculate efficiently and accurately; and to communicate precisely with others by using clear mathematical language to discuss their reasoning.
- 7. Look for and make use of structure** by expecting students to apply rules, look for patterns and analyze structure.
- 8. Look for and express regularity in repeated reasoning** by expecting students to understand broader applications and look for structure and general methods in similar situations.

Plot points $A = (-3, -1)$, $B = (-1, 2)$, $C = (4, 2)$, and $D = (2, -1)$.



1. What specialized geometric figure is quadrilateral ABCD? Support your answer mathematically.
2. Draw the diagonals of ABCD. Find the coordinates of the midpoint of each diagonal. What do you notice?
3. Find the slopes of the diagonals of ABCD. What do you notice?
4. The diagonals of ABCD create four small triangles. Are any of these triangles congruent to any of the others? Why or why not?

Plot points $E = (1, 2)$, $F = (2, 5)$, $G = (4, 3)$ and $H = (5, 6)$.



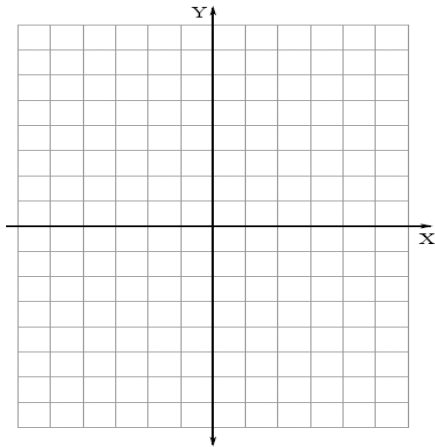
5. What specialized geometric figure is quadrilateral EFHG? Support your answer mathematically using two different methods.

6. Draw the diagonals of EFHG. Find the coordinates of the midpoint of each diagonal. What do you notice?

7. Find the slopes of the diagonals of EFHG. What do you notice?

8. The diagonals of EFHG create four small triangles. Are any of these triangles congruent to any of the others? Why or why not?

Plot points $P = (4, 1)$, $W = (-2, 3)$, $M = (2, -5)$, and $K = (-6, -4)$.



9. What specialized geometric figure is quadrilateral PWKM? Support your answer mathematically.

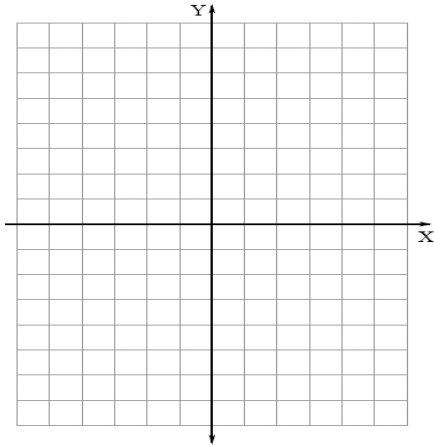
10. Draw the diagonals of PWKM. Find the coordinates of the midpoint of each diagonal. What do you notice?

11. Find the lengths of the diagonals of PWKM. What do you notice?

12. Find the slopes of the diagonals of PWKM. What do you notice?

13. The diagonals of ABCD create four small triangles. Are any of these triangles congruent to any of the others? Why or why not?

Plot points $A = (1, 0)$, $B = (-1, 2)$, and $C = (2, 5)$.



14. Find the coordinates of a fourth point D that would make $ABCD$ a rectangle. Justify that $ABCD$ is a rectangle.

15. Find the coordinates of a fourth point D that would make $ABCD$ a parallelogram that is not also a rectangle. Justify that $ABCD$ is a parallelogram but is not a rectangle.