WHICH QUADRILATERAL IS IT?

Performance Standards (9C/6B/6C).J

Use coordinate geometry to prove what kind of quadrilateral is formed when the midpoints of a quadrilateral are connected:

- *Mathematical knowledge*: Locate midpoints and classify the figure as a parallelogram;
- *Strategic knowledge*: Use the midpoint formula and slopes to prove two pairs of opposite sides are parallel or use the distance formula to prove two pairs of opposite sides are congruent, or use both to prove one pair of opposite sides are congruent and parallel;
- *Explanation*: Explain completely what was done and why it was done.

Procedures

1. Provide students with sufficient learning opportunities to develop the following in order to (9C) construct convincing arguments and proofs to solve problems, (6B) investigate, represent, and solve problems using number facts, operations and their properties, algorithms, and relationships, and (6C) compute and estimate using mental mathematics, paper-and-pencil methods, calculators, and computers.
   - Prove conjectures about geometric figures on the plane or in space using coordinate geometry.
   - Develop fluency in operations with real numbers, vectors and matrices using mental computation or paper-and-pencil calculations for simple cases and technology for more-complicated cases.
   - Determine the level of accuracy needed for computations involving measurement and irrational numbers.
   - Use the correct number of digits in computation to achieve an appropriate unit when solving problems.
2. A copy of the task is given to the student to complete and turn in. It is assumed that the student has studied and discussed the coordinate geometry methods for finding midpoints, slopes, lengths, and parallel lines. It is also assumed that the student has studied and discussed the properties of quadrilaterals and the minimum requirements for a classification.
3. A 4 in mathematical knowledge would require a correct location of midpoints and the correct classification that it is a parallelogram. A 4 in strategic knowledge would require the correct use of the midpoint formula, and either the use of slopes to prove two pairs of opposite sides parallel, or the use of the distance formula or equivalent to prove two pairs of opposite sides congruent, or the use of both to prove one pair of opposite sides congruent and parallel, or any other strategy to prove minimum conditions of a parallelogram. A 4 in explanation would require a complete explanation of the process used and the reasons for each step.

Examples of Student Work follow

Resources

- Copies of the "Which Quadrilateral Is It?" task sheet
- Mathematics Rubric

Time Requirements

- One class period

NAME _____ DATE _____

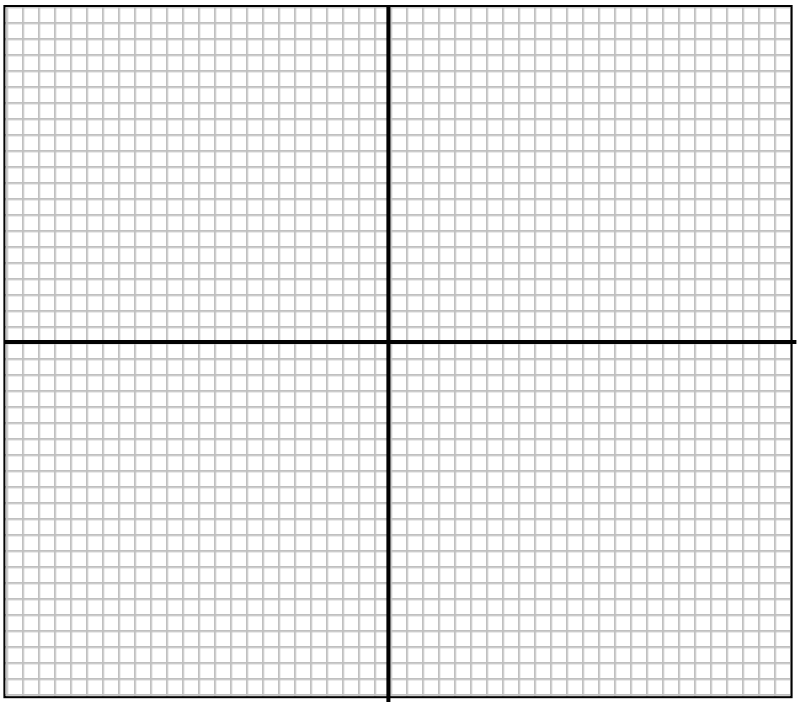
COORDINATE GEOMETRY

Student Task Sheet

Plot the points A(1, 2), B(4, 7), C(9, 3), and D(6, -2).

Use coordinate geometry to a) find the midpoints P, Q, R, and S of each side of ABCD and b) determine the most specific classification of PQRS.

Write in words how you worked the problem and why you did each step.



"Meets"

COORDINATE GEOMETRY

Student Task Sheet

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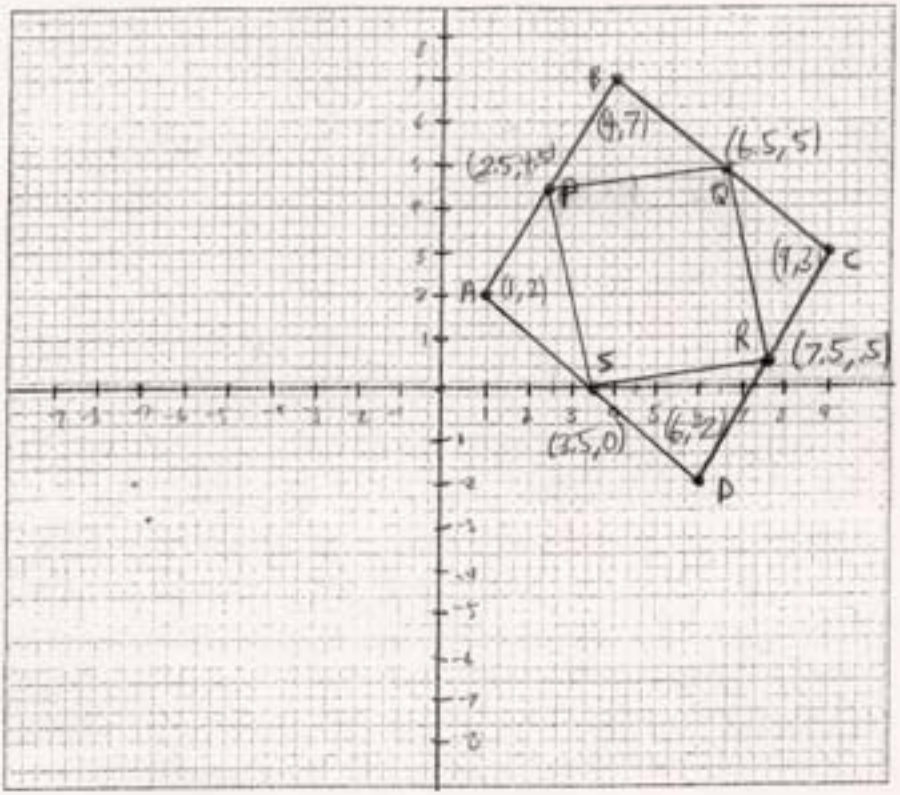

a.)

P
$\frac{4+1}{2} = (2.5, 4.5)\ \frac{7+2}{2}$ $\overline{AB}$

Q
$\frac{4+9}{2} = (6.5, 5)\ \frac{7+3}{2}$ $\overline{BC}$

R
$\frac{9+6}{2} = (7.5, .5)\ \frac{3+-2}{2}$ $\overline{CD}$

S
$\frac{1+6}{2} = (3.5, 0)\ \frac{2+-2}{2}$ $\overline{AD}$

b.)

You need to show that PQRS is a parallelogram so $\overline{PS} \parallel \overline{QR}$ & $\overline{PQ} \parallel \overline{SR}$

If the slopes are equal then it will be a parallelogram.

The slope of $\overline{PS} = m = \frac{0-4.5}{3.5-2.5} = -4.5$, slope of $\overline{QR} = m = \frac{-.5-5}{7.5-6.5} = -4.5$

Since the slopes of $\overline{PS}$ & QR are equal we know that $\overline{PS} \parallel \overline{QR}$

The slop of $\overline{PQ} = m = \frac{5-4.5}{6.5-2.5} = \frac{1}{8}$, slope of $\overline{SR} = m = \frac{-.5-0}{7.5-3.5} = \frac{1}{8}$

Since the slopes of $\overline{PQ}$ & $\overline{SR}$ are equal we know that $\overline{PQ} \parallel \overline{SR}$

Since $\overline{PS} \parallel \overline{QR}$ & $\overline{PQ} \parallel \overline{SR}$ then PQRS is a parallelogram.