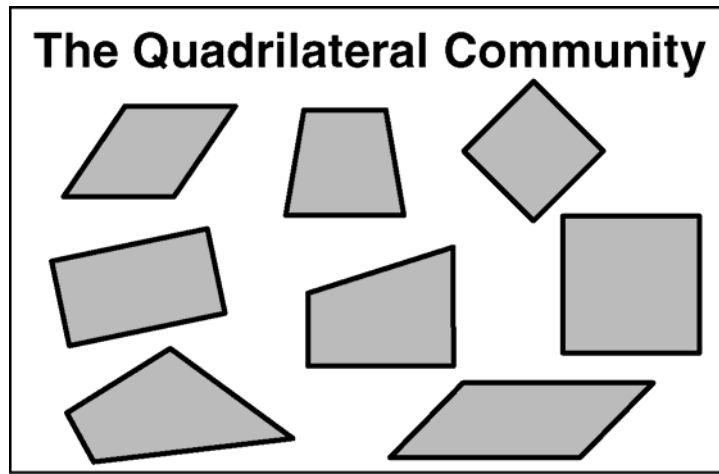


Common Core Mathematics Challenge



Level: Grade Five

Domain: Geometry

Cluster: Classify two-dimensional figures into categories based on their properties.

Standards

Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category.

Classify two-dimensional figures in a hierarchy based on properties.

Common Core Mathematics Challenge
Geometry
Grade 5–The Quadrilateral Community

The purpose of the Mathematics Challenges is to provide opportunities for students to develop and demonstrate understanding of important mathematical concepts and standards. Each Challenge includes a set of tasks that require higher-order thinking skills. Because these types of tasks may be new for students and they will have varying levels of understanding, the student responses will vary. The Challenges and guiding questions were designed to help teachers plan their implementation and elicit, analyze, and act on evidence of student understanding.

Each packet contains all the materials necessary to implement the Mathematics Challenge including a grade-appropriate Challenge, the Mathematics Challenge Meeting Protocol, and the Guiding Questions for Analyzing Student Responses to Mathematics Challenges.

For each Challenge, you will complete a six step process of planning, implementation, and analysis and reflection.

The Mathematics Challenge Process

Stage	Step	Task
Planning	Step 1.	Review the Mathematics Challenge Meeting Protocol
	Step 2.	Review and solve the Mathematics Challenge prior to your Professional Learning Community meeting. Think about your responses to the guiding questions on the Meeting Protocol
	Step 3.	Hold your Professional Learning Community meeting and discuss your responses to the Guiding Questions on the Meeting Protocol
Implementation	Step 4.	Implement the Mathematics Challenge with your class
Analysis and Reflection	Step 5.	For your own planning and documentation, respond to the Guiding Questions on the Analyzing Student Responses Protocol
	Step 6.	To help us improve the Challenges and to provide recommendations for teachers implementing them in future years, complete the Mathematics Challenge Feedback Log and provide copies of all student work to the Assessment Coordinator

Common Core Mathematics Challenge
Geometry
Grade 5–The Quadrilateral Community

Mathematics Challenge Meeting Protocol

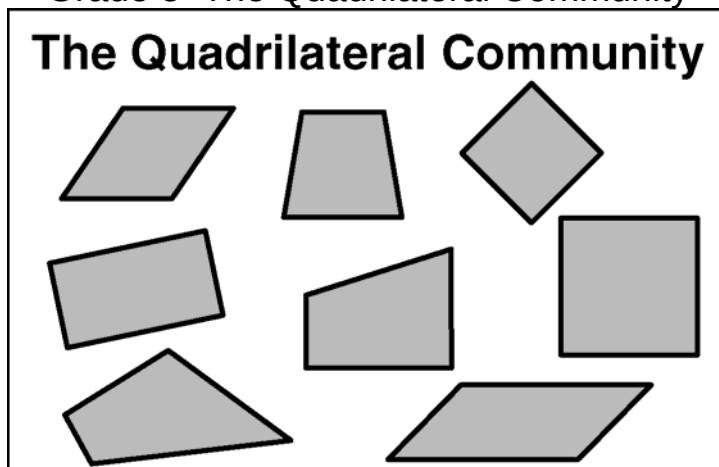
Your Professional Learning Community will meet to discuss the implementation of one Mathematics Challenge. In preparation for your meeting, please print and review the Mathematics Challenge, solve all tasks within the Challenge, and think about the guiding questions below. These questions will be used to facilitate a group discussion regarding the implementation of the upcoming Mathematics Challenge.

Guiding Questions for Implementing the Mathematics Challenges

1. What is the title of the Challenge that you will use?
2. What skills or standards is this Challenge measuring?
3. Where does this Challenge fit within your curriculum? Within which unit?
4. At what point during the unit will you administer this Challenge (e.g., At the beginning of a unit to determine what students do or do not know, at the end of a unit to assess what students have or have not learned, in the middle of a unit to determine where to go next instructionally)?
5. How will your students complete this Challenge (e.g., individually, one-on-one, in small groups, as a class)? Why?
6. Are there any prerequisite skills, common misunderstandings, or vocabulary needs that you will have to address? What are they?
7. What difficulties do you anticipate your students will have with the Challenge? How will you address them?
8. Are these skills and difficulties different for special needs students, ELL students, etc.? How? Will you do anything different for these students? What?
9. How will you evaluate student responses (e.g., grade responses with the provided rubric, scan responses to identify common mistakes/misconceptions, have students evaluate one another's responses, have students evaluate their own response)?
10. What will student responses to this Challenge tell you about student understanding?
11. How might you use this evidence of student understanding to adapt your teaching and learning?
12. What other materials, resources, or support might you need? Where can you get them?
13. How can your colleagues assist you in the analysis of student understanding?
14. What other questions or concerns do you have about this Mathematics Challenge?

After you have implemented the challenge with your class, be sure to respond to the Guiding Questions on the Analyzing Student Responses Protocol.

Common Core Mathematics Challenge
Geometry
Grade 5–The Quadrilateral Community



Domain: Geometry

Cluster: Classify two-dimensional figures into categories based on their properties.

Standards:

Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category.

Classify two-dimensional figures in a hierarchy based on properties.

Task Preparation:

Each student will need a copy of the Student Response Sheet.

Stimulus Cards (Drawing or Word Description):

Word Bank

Manipulatives/Supplies:

Pencils

Common Core Mathematics Challenge
Geometry
Grade 5–The Quadrilateral Community

Cues/Directions:

Distribute student response sheets. Students should be directed to look carefully at each figure. Allow students time to answer.

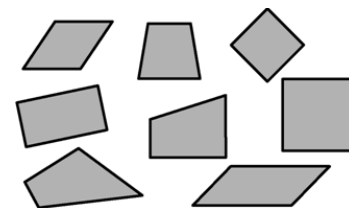
- 1. Instruct students to follow along as you read aloud and say: There are many different shapes in the quadrilateral community. Some of the shapes are shown below. The shapes labeled C, F, and H have something in common that the other shapes do not have. What is it? (TEACHER NOTE: Students should write their explanation in the box.) Choose a word from the word bank for shapes C, F, and H. (TEACHER NOTE: Students should write their correct answer on the line.) The shapes labeled A, D, E, G, and I have something in common that the other shapes do not have. What is it? (TEACHER NOTE: Students should write their explanation in the box.) Choose a word from the word bank for shapes A, D, E, G, and I. (TEACHER NOTE: Students should write their correct answer on the line.) The shapes labeled D, G, and I have something in common that the other shapes do not have. What is it? (TEACHER NOTE: Students should write their explanation in the box.) Choose a word from the word bank for shapes D, G, and I. (TEACHER NOTE: Students should write their correct answer on the line.) The shapes labeled A, D, and I have something in common that the other shapes do not have. What is it? (TEACHER NOTE: Students should write their explanation in the box.) Choose a word from the word bank for shapes A, D, and I. (TEACHER NOTE: Students should write their correct answer on the line.) The shapes labeled D and I have something in common that the other shapes do not have. What is it? (TEACHER NOTE: Students should write their explanation in the box.) Choose a word from the word bank for shapes D and I. (TEACHER NOTE: Students should write their correct answer on the line.) The shape labeled B has only one thing in common with all the other shapes. What is it? (TEACHER NOTE: Students should write their explanation in the box.)**
- 2. Some of the quadrilaterals on page 1 have more than one classification. Fill in the chart below by placing an X in the column of ALL of the classifications that describe each quadrilateral. Shape A is already filled in. (TEACHER NOTE: Students should fill in the rest of the table.)**

Common Core Mathematics Challenge
Geometry
Grade 5–The Quadrilateral Community

- 3. Draw exactly 5 quadrilaterals on the grid below by connecting dots. Your 5 shapes should fit the following classifications. (TEACHER NOTE: This may be a stretch for some students. Students should use the dot paper to write exactly 5 quadrilaterals that satisfy given conditions.) Choose one quadrilateral you drew that has more than one classification. Tell why it has more than one name. (TEACHER NOTE: Students should write their explanation in the box.) Look at the rectangles that you drew. Is every rectangle also a square? (TEACHER NOTE: Have students check the correct box.) How do you know? (TEACHER NOTE: Students should write their explanation in the box.)**

Common Core Mathematics Challenge
Geometry
Grade 5—The Quadrilateral Community

Common Core Mathematics Challenge
Geometry
Grade 5–The Quadrilateral Community

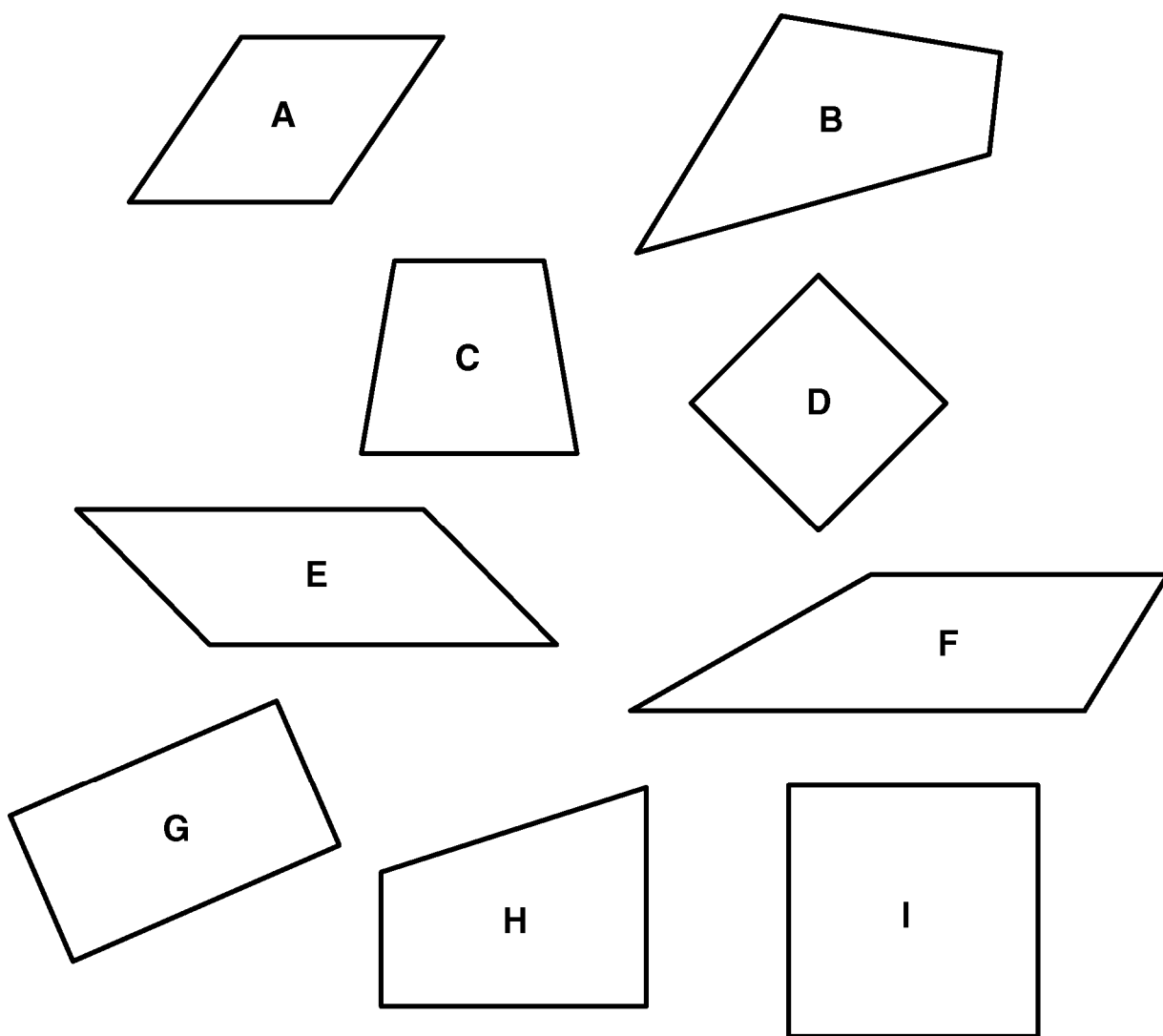


Student Response Sheet
The Quadrilateral Community

Name: _____

Date: _____

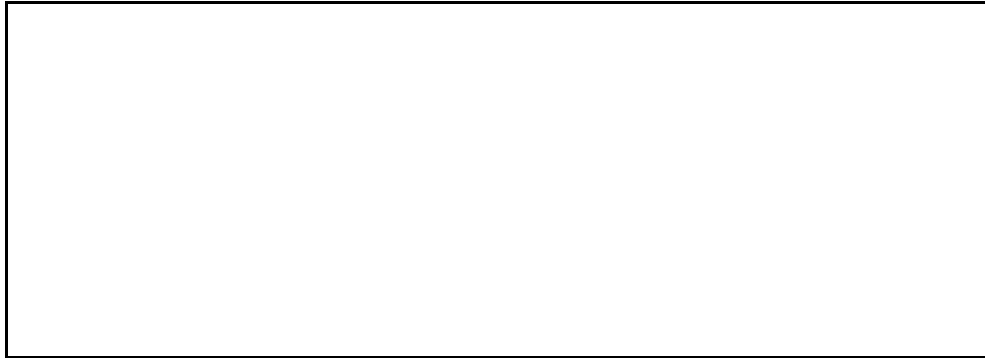
- 1. There are many different shapes in the quadrilateral community. Some of the shapes are shown below.**



Common Core Mathematics Challenge
Geometry
Grade 5–The Quadrilateral Community

- a. The shapes labeled C, F, and H have something in common that the other shapes do not have.

What is it?



Choose a word from the word bank for shapes C, F, and H.

- b. The shapes labeled A, D, E, G, and I have something in common that the other shapes do not have.

What is it?



Choose a word from the word bank for shapes A. D. E. G. and I.

Common Core Mathematics Challenge
Geometry
Grade 5–The Quadrilateral Community

- c. The shapes labeled D, G, and I have something in common that the other shapes do not have.

What is it?



Choose a word from the word bank for shapes D, G, and I.

- d. The shapes labeled A, D, and I have something in common that the other shapes do not have.

What is it?

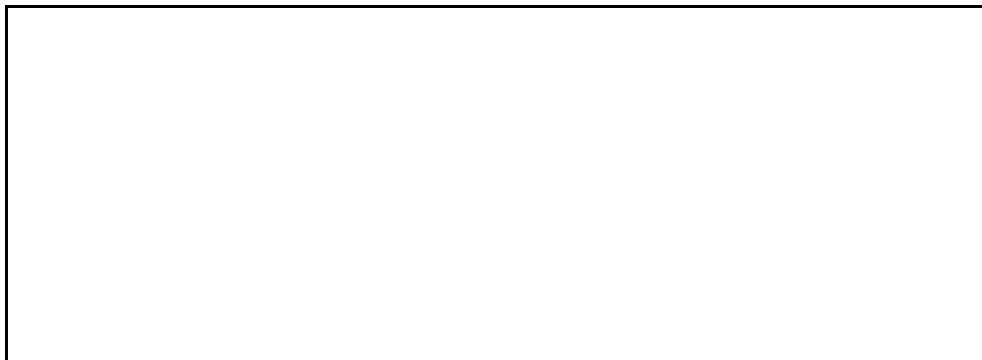


Choose a word from the word bank for shapes A, D, and I.

Common Core Mathematics Challenge
Geometry
Grade 5–The Quadrilateral Community

- e. The shapes labeled D and I have something in common that the other shapes do not have.**

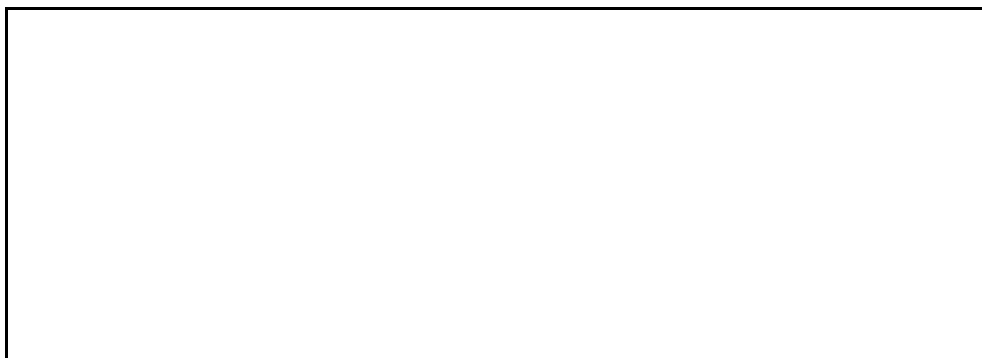
What is it?



Choose a word from the word bank for shapes D and I.

- f. The shape labeled B has only one thing in common with all the other shapes.**

What is it?



Common Core Mathematics Challenge
Geometry
Grade 5–The Quadrilateral Community

2. Some of the quadrilaterals on page 1 have more than one classification. Fill in the chart below by placing an X in the column of ALL of the classifications that describe each quadrilateral. Shape A is already filled in.

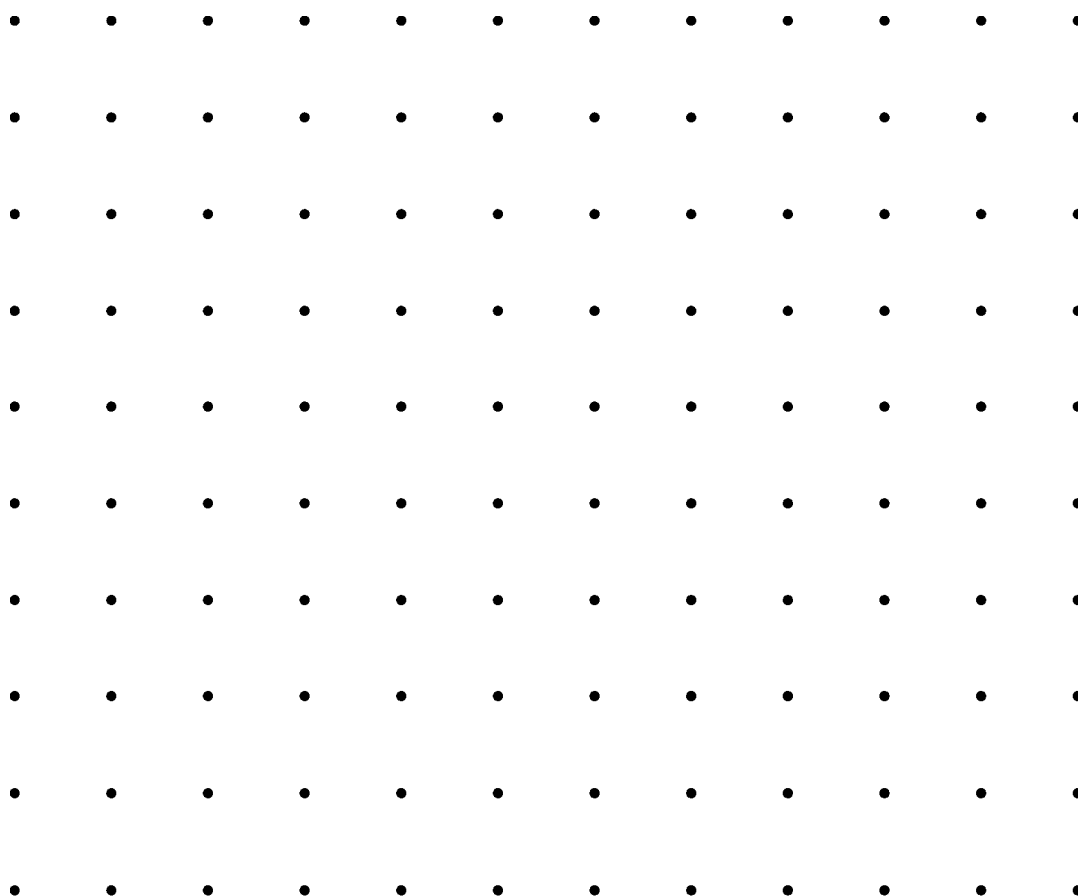
Shape	Classification				
	Parallelogram	Rectangle	Rhombus	Square	Trapezoid
A	X		X		
B					
C					
D					
E					
F					
G					
H					
I					

Common Core Mathematics Challenge
Geometry
Grade 5–The Quadrilateral Community

3. Draw exactly 5 quadrilaterals on the grid below by connecting dots. Your 5 shapes should fit the following classifications.

- 3 parallelograms
- 2 rectangles
- 1 rhombus
- 1 square
- 1 trapezoid
- 1 quadrilateral with no other classification

Remember: One shape can fit more than one classification.



Common Core Mathematics Challenge
Geometry
Grade 5–The Quadrilateral Community

- a. Choose one quadrilateral you drew that has more than one classification. Tell why it has more than one name.



- b. Look at the rectangles that you drew. Is every rectangle also a square?

Check one:

☐

Yes

☐

No

How do you know?



Common Core Mathematics Challenge
Geometry
Grade 5—The Quadrilateral Community

Word Bank

Each word in the word bank can only be used once.

Parallelogram

Rectangle

Rhombus

Square

Trapezoid

Common Core Mathematics Challenge
Geometry
Grade 5–The Quadrilateral Community

Learning and Teaching Considerations

Task 1:

- A)** Be sure that students understand that an array of geometric properties can determine what makes shapes alike and different. For example, shapes have sides that are parallel, perpendicular, or neither; they have line symmetry, rotational symmetry, or neither; and they are similar, congruent, or neither.
- B)** Be sure that students understand that in the classification of quadrilaterals and parallelograms, the subsets are not all disjoint. For example, a square is a rectangle and a rhombus.
- C)** There are two different definitions of trapezoid. One specifies only one pair of parallel sides, and the other specifies at least one pair of parallel sides. If the second definition is in use, all parallelograms are trapezoids, but not all trapezoids are parallelograms.
- D)** If a student says or writes, “I just know,” prompt him or her by saying something like “I’m glad you know, but it’s important in math to be able to explain your answers so other people can understand what you’re thinking.”
- E)** If a student says or writes, “I don’t know,” say something positive like “Let’s start with what you do know about this problem.” Students often know more than they think or say, and encouraging them to vocalize or write about that knowledge is all they need.
- F)** Students may fold the paper along a line of symmetry or use a ruler or protractor to measure sides or angles. Teachers can tell students that the tools are available if they need them.

Task 2:

- A)** Students may recognize a square as a rhombus, a rectangle, a parallelogram, and possibly a trapezoid, depending on the definition used.
- B)** Students may have the misconception that a square is not a type of rectangle.

Common Core Mathematics Challenge
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Grade 5–The Quadrilateral Community

- C) Teachers can encourage students to focus more on properties of figures rather than on simple identification. As new geometric concepts are learned, the number of properties that figures have can be expanded.
- D) Teachers can encourage students to examine properties of shapes to determine necessary and sufficient conditions for different shape classifications.
- E) Teachers can encourage the making and testing of student-constructed hypotheses or conjectures.

Task 3:

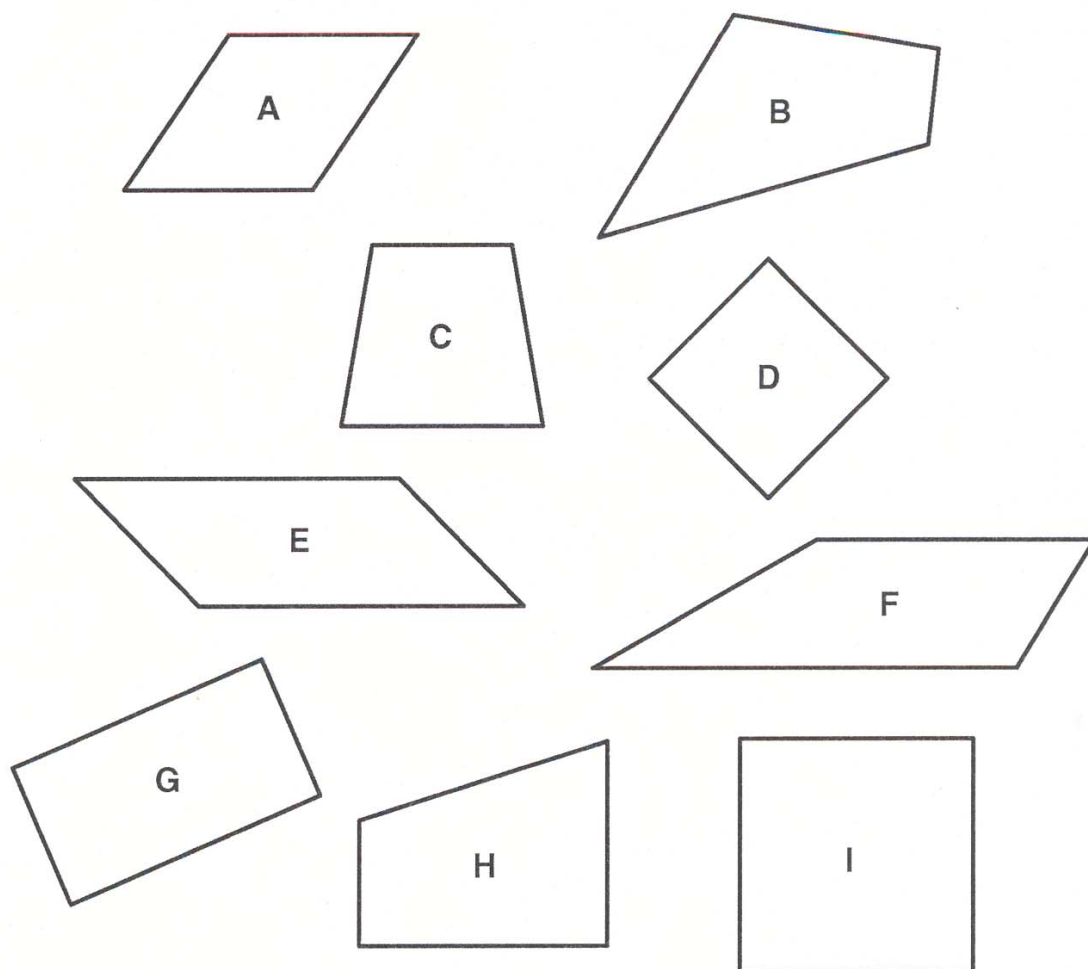
- A) Students may have the misconception that a rectangle is not a type of parallelogram.
- B) Students may recognize that every square is a rhombus, but not every rhombus is a square, based on their definitions.
- C) Students may have the misconception that a rhombus cannot also be a rectangle.
- D) Students may recognize that every rectangle is not always a square. They may explain why based on their definitions.

Common Core Mathematics Challenge
Geometry
Grade 5–The Quadrilateral Community

Name: ANSWER KEY

Date: _____

1. There are many different shapes in the quadrilateral community. Some of the shapes are shown below.



Common Core Mathematics Challenge
Geometry
Grade 5–The Quadrilateral Community

- a. The shapes labeled C, F, and H have something in common that the other shapes do not have.

What is it?

ONLY 1 PAIR OF PARALLEL SIDES
OR
ONLY 2 SIDES THAT ARE PARALLEL

Choose a word from the word bank for shapes C, F, and H.

TRAPEZOID

- b. The shapes labeled A, D, E, G, and I have something in common that the other shapes do not have.

What is it?

2 PAIRS OF PARALLEL SIDES
OR
OPPOSITE SIDES ARE PARALLEL

Choose a word from the word bank for shapes A, D, E, G, and I.

PARALLELOGRAM

Common Core Mathematics Challenge
Geometry
Grade 5–The Quadrilateral Community

- c. The shapes labeled D, G, and I have something in common that the other shapes do not have.

What is it?

ALL ANGLES ARE RIGHT
ANGLES.

Choose a word from the word bank for shapes D, G, and I.

RECTANGLE

- d. The shapes labeled A, D, and I have something in common that the other shapes do not have.

What is it?

ALL SIDES ARE THE SAME
LENGTH, AND OPPOSITE SIDES
ARE PARALLEL.

Choose a word from the word bank for shapes A, D, and I.

RHOMBUS

Common Core Mathematics Challenge
Geometry
Grade 5—The Quadrilateral Community

- e. The shapes labeled D and I have something in common that the other shapes do not have.

What is it?

4 RIGHT ANGLES AND ALL
SIDES ARE THE SAME LENGTH.

Choose a word from the word bank for shapes D and I.

SQUARE

- f. The shape labeled B has only one thing in common with all the other shapes.

What is it?

IT HAS 4 SIDES.

Common Core Mathematics Challenge
 Geometry
 Grade 5–The Quadrilateral Community

2. Some of the quadrilaterals on page 1 have more than one classification. Fill in the chart below by placing an X in the column of ALL of the classifications that describe each quadrilateral. Shape A is already filled in.

Shape	Classification				
	Parallelogram	Rectangle	Rhombus	Square	Trapezoid
A	X		X		
B					
C					X
D	X	X	X	X	
E	X				
F					X
G	X	X			
H					X
I	X	X	X	X	

NOTE: THESE ANSWERS USE THE DEFINITION OF A TRAPEZOID HAVING ONLY 1 PAIR OF PARALLEL SIDES. IF THE DEFINITION OF AT LEAST 1 PAIR IS USED, THEN ALL SHAPES EXCEPT B CAN BE CHECKED.

Common Core Mathematics Challenge
Geometry
Grade 5–The Quadrilateral Community

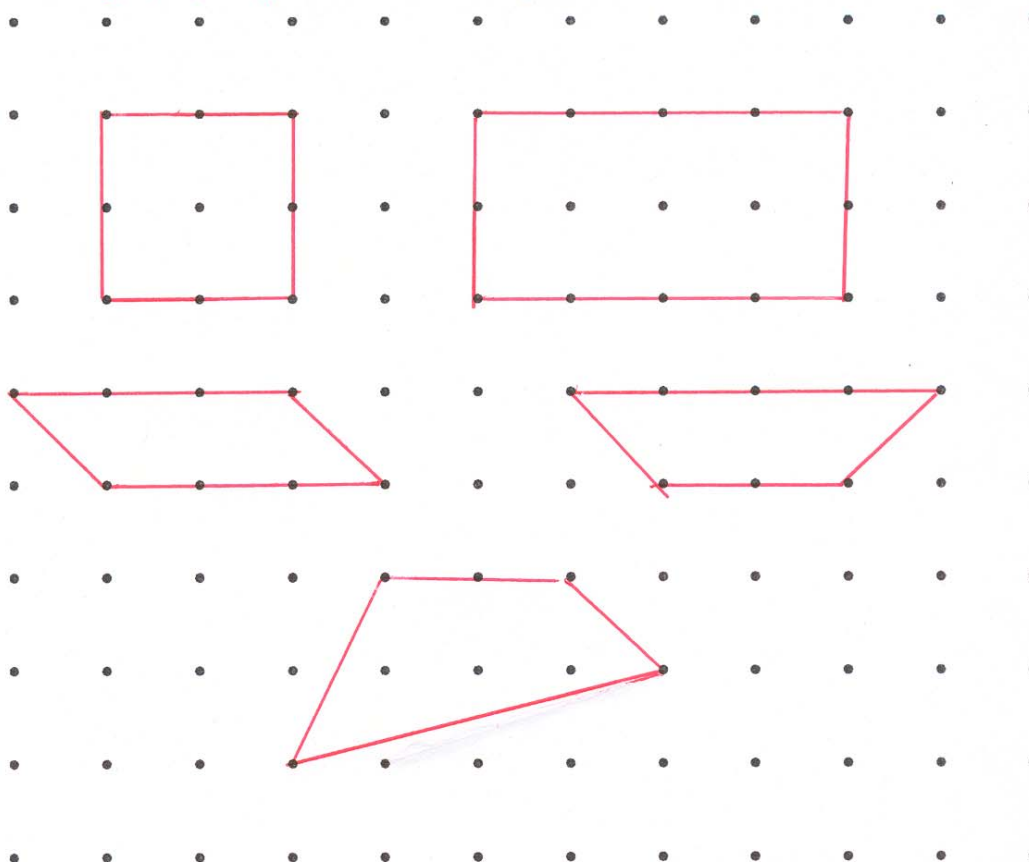
3. Draw exactly 5 quadrilaterals on the grid below by connecting dots. Your 5 shapes should fit the following classifications.

- 3 parallelograms
- 2 rectangles
- 1 rhombus
- 1 square
- 1 trapezoid
- 1 quadrilateral with no other classification

NOTE: THERE
ARE MANY
WAYS TO DO THIS.

Remember: One shape can fit more than one classification.

ONE POSSIBLE SOLUTION BELOW:



Common Core Mathematics Challenge
Geometry
Grade 5–The Quadrilateral Community

- a. Choose one quadrilateral you drew that has more than one classification. Tell why it has more than one name.



A square is a

- ☐ rectangle because it has 4 right angles and opposite sides are parallel
- ☐ parallelogram because opposite sides are parallel
- ☐ rhombus because opposite sides are parallel and all sides are the same length

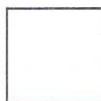
A rectangle is a

- ☐ parallelogram because opposite sides are parallel



- b. Look at the rectangles that you drew. Is every rectangle also a square?

Check one:

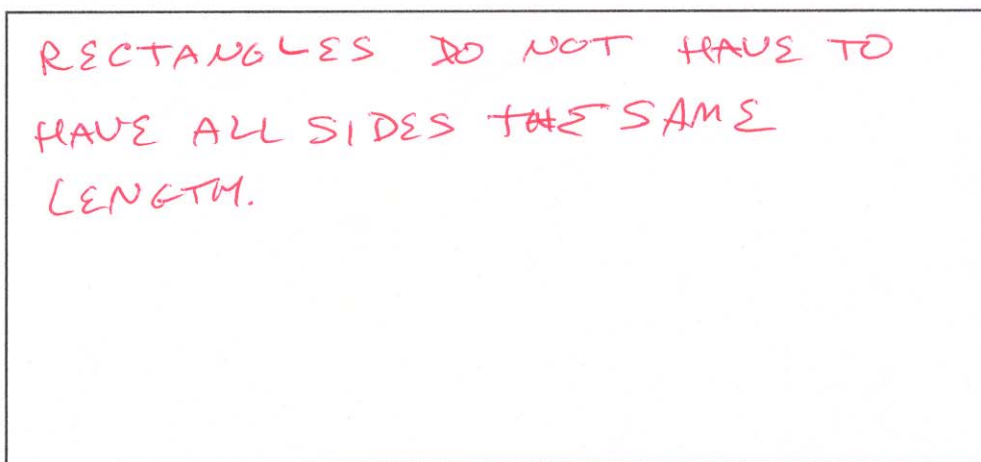


Yes



No

How do you know?



Common Core Mathematics Challenge
Geometry
Grade 5—The Quadrilateral Community

Common Core Mathematics Challenge
Geometry
 Grade 5–The Quadrilateral Community Rubric

Category	4	3	2	1
Mathematical concepts	Response shows complete understanding of the mathematical concepts used to solve the problem(s).	Response shows substantial understanding of the mathematical concepts used to solve the problem(s).	Response shows some understanding of the mathematical concepts needed to solve the problem(s).	Response shows very limited understanding of the underlying concepts needed to solve the problem(s), OR the response is not written.
	Response shows evidence in 9 or 10 of the following tasks. Task 1a. Student identifies trapezoids and provides a correct definition. Task 1b. Student identifies parallelograms and provides a correct definition. Task 1c. Student identifies rectangles and provides a correct definition. Task 1d. Student identifies rhombuses and provides a correct definition. Task 1e. Student identifies squares and provides a correct definition. Task 1f. Student identifies having 4 sides as the common characteristic. Task 2. Student completes table, as shown on answer sheet. Task 3. Student is able to draw 5 shapes that meet the given specifications. Task 3a. Student is able to tell why a square or a rectangle fits other classifications based on a definition. Task 3b. Student answers that every rectangle is not always a square and explains why based on a definition.	Response shows evidence in only 7 or 8 of the tasks described in category 4.	Response shows evidence in only 5 or 6 of the tasks described in category 4.	Response shows evidence in 4 or fewer of the tasks described in category 4.

Common Core Mathematics Challenge
Geometry
 Grade 5–The Quadrilateral Community Rubric

Category	4	3	2	1
Strategy and procedures	Student typically uses an efficient and effective strategy to solve the problem(s).	Student typically uses an effective strategy to solve the problem(s).	Student sometimes uses an effective strategy to solve the problem(s), but not consistently.	Student rarely uses an effective strategy to solve the problem(s).
	Response shows evidence in ALL of the following tasks. Task 1. In all parts, student may show evidence of using a ruler and/or a protractor to determine measures of sides and angles. Task 3. Student may show evidence of drawing and erasing to fit in the desired number of shapes.	Response shows evidence in ALL of the tasks described in category 4, but there may be 1 or 2 errors in task 1.	Response shows evidence in only 1 of the tasks described in category 4.	Response shows no evidence of measuring sides or angles of shapes in tasks 1 and 3.

Common Core Mathematics Challenge
Geometry
 Grade 5–The Quadrilateral Community Rubric

Category	4	3	2	1
Explanation and communication	Explanation is detailed and clear; uses appropriate terminology and/or notation.	Explanation is clear; uses some appropriate terminology and/or notation.	Explanation is a little difficult to understand, but includes critical components; shows little use of appropriate terminology and/or notation.	Explanation is difficult to understand, is missing several components, and does not use or include appropriate terminology and/or notation.
	Response shows evidence in ALL of the following tasks. Task 1a. Student explains that each shape has only 1 pair or at least one pair of parallel sides, depending on the definition used in class. (The definition of a trapezoid varies among textbooks.) Task 1b. Student explains that each shape has 2 pairs of parallel sides. Task 1c. Student explains that each shape has 4 right or 90-degree angles. Explanation can also include bisecting diagonals. Task 1d. Student explains that each shape has sides of the same length. Explanation can also include bisecting diagonals. Task 1e. Student explains that each shape has sides of the same length <u>and</u> 4 right angles. Explanation can also include bisecting diagonals. Task 1f. Student explains that the shape has 4 sides and that is the only thing in common with the other shapes. Task 3. Student explains why the square or the rectangle can have other classifications. Note: If alternate definition of trapezoid is in use, there may be other answers. Student explains why every rectangle is <u>not</u> also a square.	Response shows evidence in only 5 or 6 explanations described in category 4.	Response shows evidence in only 3 or 4 explanations described in category 4.	Response shows evidence in 2 or fewer explanations described in category 4.

Common Core Mathematics Challenge
Geometry
 Grade 5–The Quadrilateral Community Rubric

Category	4	3	2	1
Mathematical accuracy	All or almost all of the steps and solutions have no mathematical errors.	Most of the steps and solutions have no mathematical errors.	Some of the steps and solutions have no mathematical errors.	Few of the steps and solutions have no mathematical errors.
	Student provides correct answers for ALL of the following tasks. Task 1. Student identifies all shapes, as shown on answer sheet. Task 2. Student completes table, as shown on answer sheet. Note: The answer sheet uses the definition of trapezoid as having exactly 1 pair of parallel sides. If the definition of at least 1 pair is used, all shapes except B will satisfy the condition. Task 3. Student draws exactly 5 quadrilaterals that meet the given conditions. Student answers no in part (b).	Student provides correct identifications for ALL parts of task 1. Student has 1 or 2 errors in completing the table for task 2. Student provides correct drawings in task 3.	Student provides correct identifications for ALL parts of task 1. Student has more than 2 errors in completing the table of task 2. Student is not able to draw 5 quadrilaterals to meet given conditions in task 3.	Student has errors in each of the three tasks described in category 4.

Common Core Mathematics Challenge
Geometry
 Grade 5–The Quadrilateral Community

Scoring Notes Checklist

Task	Check Yes	Category
Task 1		
Student identifies trapezoids and provides a correct definition in part (a). Student identifies parallelograms and provides a correct definition in part (b). Student identifies rectangles and provides a correct definition in part (c). Student identifies rhombuses and provides a correct definition in part (d). Student identifies squares and provides a correct definition in part (e). Student identifies having 4 sides as the common characteristic in part (f).		Concepts
In all parts, student may show evidence of using a ruler and/or a protractor to determine measures of sides and angles.		Strategy
In part (a) student explains that each shape has only 1 pair or at least one pair of parallel sides, depending on the definition used in class. In part (b) student explains that each shape has 2 pairs of parallel sides. In part (c) student explains that each shape has 4 right or 90-degree angles. Explanation can also include bisecting diagonals. In part (d) student explains that each shape has sides of the same length. Explanation can also include bisecting diagonals. In part (e) student explains that each shape has sides of the same length <u>and</u> 4 right angles. Explanation can also include bisecting diagonals. In part (f) student explains that the shape has 4 sides and that is the only thing in common with the other shapes.		Explanation
Student identifies all shapes, as shown on answer sheet.		Accuracy
Task 2		
Student completes table, as shown on answer sheet.		Concepts
Student completes table, as shown on answer sheet. Note: The answer sheet uses the definition of trapezoid as having exactly 1 pair of parallel sides. If the definition of at least 1 pair is used, all shapes except B will satisfy the condition.		Accuracy
Task 3		
Student is able to draw 5 shapes that meet the given specifications. In part (a) student is able to tell why a square or a rectangle fits other classifications based on a definition. In part (b) student answers that every rectangle is not always a square and explains why based on a definition.		Concept
Student may show evidence of drawing and erasing to fit in the desired number of shapes.		Strategy
Student explains why the square or the rectangle can have other classifications. Note: If alternate definition of trapezoid is in use, there may be other answers. Student explains why every rectangle is <u>not</u> also a square.		Explanation
Student draws exactly 5 quadrilaterals that meet the given conditions. Student answers no in part (b).		Accuracy

Common Core Mathematics Challenge
Geometry
Grade 5—The Quadrilateral Community

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Analyzing Student Responses Protocol

The purpose of the Mathematics Challenges is to provide opportunities for students to develop and demonstrate understanding of important mathematical concepts and standards. They include extended responses, open-ended tasks, and tasks that require higher-order thinking skills. Because these types of tasks may be novel for students and they will have varying levels of understanding, the student responses will vary.

The guiding questions below were designed to assist you in analyzing your class' response to the Challenge and determining appropriate next steps for your teaching and learning.

Guiding Questions for Analyzing Student Responses to the Mathematics Challenges

1. When completing the Challenge, what did your students do well? How do you know?

2. When completing the Challenge, what did your students struggle with? How do you know?

3. When your students completed the Challenge, did they implement multiple correct solutions strategies? What insightful approaches to problem solving did you observe?

Common Core Mathematics Challenge
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Grade 5—The Quadrilateral Community

4. What, if any, patterns (e.g., common errors/misconceptions) did you observe across your student responses?
5. What questions or concerns did your students have when working through this Challenge or a particular task? Are these things you should address for the class as a whole?
6. What, if any, feedback did you provide to your class? How did you provide it?
7. What did you learn about your students' mathematical understanding based on their responses to this Challenge?