Parallel Lines Under Transformations

Use slopes to test whether transformed parallel segments stay parallel

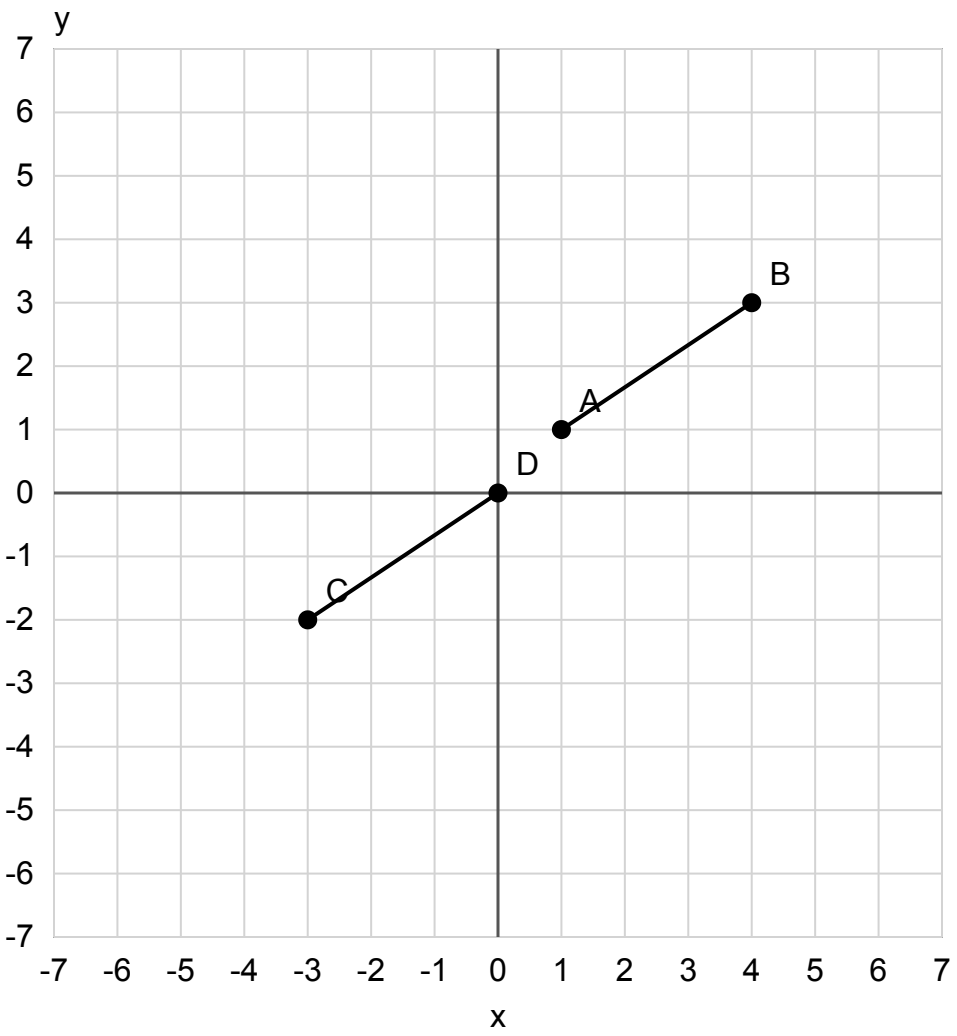
Name: _____ Date: _____

Part 1: Experimental Challenge

Materials: pencil, ruler, and 3 small sheets of tracing paper.

Segments AB and CD are parallel. Trace both segments and the axes onto tracing paper. Make a separate image for each rule below. Plot the transformed endpoints and draw each image segment with a ruler. Use rise and run as evidence. Do not decide from appearance alone.

1. Translation: (x, y) -> (x + 2, y - 3)
2. Reflection across the y-axis: (x, y) -> (-x, y)
3. Rotation 90 degrees counterclockwise about the origin: (x, y) -> (-y, x)



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Part 2: Translation Evidence

1. Translate: (x, y) -> (x + 2, y - 3)

Use your tracing or the rule to write the image endpoints. Then find each slope using rise/run. The image segments are parallel when their slopes are equal.

Image segment	Image endpoints	Slope
A'B'		
C'D'		

Are the slopes equal? Circle one: Yes / No

Evidence: Write both slopes.

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Part 3: Reflection, Rotation, and Conclusion

2. Reflect across the y-axis: (x, y) -> (-x, y)

Image segment	Image endpoints	Slope
A'B'		
C'D'		

3. Rotate 90 degrees counterclockwise: (x, y) -> (-y, x)

Image segment	Image endpoints	Slope
A'B'		
C'D'		

Conclusion: Are parallel segments mapped to parallel segments? Use slope evidence from all three transformations.

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Answer Key: Student Work

1. Translation: (x, y) -> (x + 2, y - 3)

Image segment	Image endpoints	Slope
A'B'	A'(3, -2), B'(6, 0)	(0 - -2)/(6 - 3) = 2/3
C'D'	C'(-1, -5), D'(2, -3)	(-3 - -5)/(2 - -1) = 2/3

Slopes are equal: **Yes.**

2. Reflection across the y-axis: (x, y) -> (-x, y)

Image segment	Image endpoints	Slope
A'B'	A'(-1, 1), B'(-4, 3)	(3 - 1)/(-4 - -1) = -2/3
C'D'	C'(3, -2), D'(0, 0)	(0 - -2)/(0 - 3) = -2/3

3. Rotation 90 degrees counterclockwise: (x, y) -> (-y, x)

Image segment	Image endpoints	Slope
A'B'	A'(-1, 1), B'(-3, 4)	(4 - 1)/(-3 - -1) = -3/2
C'D'	C'(2, -3), D'(0, 0)	(0 - -3)/(0 - 2) = -3/2

Conclusion sample: Yes. In each transformation, the two image segments have equal slopes. The translation gives slopes of 2/3, the reflection gives slopes of -2/3, and the rotation gives slopes of -3/2. Therefore, the images remain parallel.

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Teaching Notes

Exact setup: Print and supply all student pages, keeping teacher-key pages separate. Give each student a pencil, ruler, and three small tracing-paper sheets. Students need the Part 1 coordinate grid visible while completing Parts 2 and 3. Have students label one tracing sheet T, one R, and one 90.

Supplied materials: coordinate grid with AB and CD, transformation rules, evidence tables, and conclusion lines.

Additionally needed: pencil, ruler, and tracing paper.

Teaching script: Say: “Trace both segments and the axes together. For each rule, transform every endpoint using that same rule. Then use rise over run to compare the directions of the two image segments. A picture that looks parallel is not enough evidence.” Before students write, say: “Your claim must use the slopes you recorded.”

Observation method: While students work, check that each tracing contains both original segments and that a single stated rule is applied to all four endpoints. Check that each slope uses endpoints from its own image segment. Accept a conclusion only if it cites equal slopes for all three transformations. If a student reverses a slope sign after a reflection or rotation but gets equal slopes for both segments, ask the student to recount rise and run in one consistent left-to-right direction.

Rubric: A complete response states that the image segments have equal slopes after all three transformations and therefore remain parallel. Accept equivalent slope calculations and equivalent explanations. A student may note that reflection and rotation change the slope value while preserving equality between the two image slopes.

Source credit: New York Next Generation Mathematics Learning Standards, NY-8.G.1.c, “Verify experimentally parallel lines are mapped to parallel lines.” https://lessonmakerpro.com/standards/ny-nextgen-math/ny-8-g-1-c