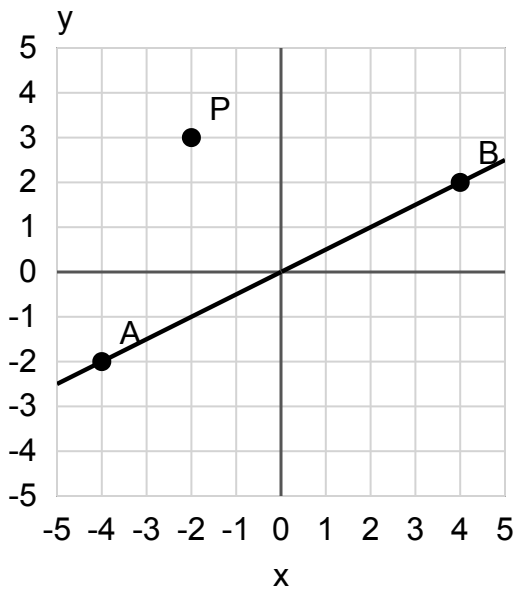
Slopes Build Line Relationships

Use slope and coordinates to prove lines are parallel or perpendicular

Name: _____ Date: _____

Part 1: A line through a point

On the coordinate plane, line l passes through A(-4, -2) and B(4, 2). Point P is (-2, 3). Use slope to create one line through P parallel to l and one line through P perpendicular to l. Then find where the perpendicular line meets l.



1. Find the slope of l. Write an equation for l.

2. Write an equation of line p through P parallel to l. Explain why p is parallel to l.

3. Write an equation of line n through P perpendicular to l. Solve the two equations to find Q, the intersection of n and l. State the geometric conclusion about l and n.

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Part 2: Horizontal and vertical lines

Consider horizontal line h: y = 4 and vertical line v: x = -3.

Question	Your work and answer
4. What is the slope of h?	
5. What is the slope of v? Write the word used for this slope.	
6. Find the coordinates where h and v intersect.	

7. Are h and v parallel, perpendicular, or neither? Justify your answer using their directions and slopes. A vertical slope is undefined, so do not use the negative-reciprocal rule with it.

8. Compare this pair with l and n from Part 1. How can you recognize perpendicular lines in both situations?

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Answer key and teaching notes

Materials and setup: Print and supply all student pages, keeping teacher-key pages separate. Students need a pencil, ruler, and optional graphing calculator for checking only. No calculator is needed. Give each student the coordinate diagram in Part 1. Keep the diagram visible while students work; do not draw lines p or n for them.

Teaching script: Say: “Slope tells a line's direction. Lines with equal slopes are parallel. For nonvertical lines, perpendicular slopes are negative reciprocals. Today, use equations to verify a line relationship, not just the picture. A vertical line is a special case: its slope is undefined.” Ask students to read Part 1 silently. After item 3, say: “An intersection must make both equations true.” Before Part 2, say: “For a horizontal and vertical pair, use direction as well as slope. Do not take a negative reciprocal of undefined.”

Observation method: Circulate and record whether each student (a) computes slope as rise/run, (b) uses equal slopes for parallel lines, (c) changes the sign and inverts a nonzero slope for a perpendicular line, (d) substitutes or solves accurately for Q, and (e) calls a vertical slope undefined rather than a number. Prompt only: “Which two points did you use?” or “Does your point satisfy both equations?”

Answers:
1. m = (2 - (-2))/(4 - (-4)) = 4/8 = 1/2. Line l: y = (1/2)x.
2. Parallel slope is 1/2. Through P(-2, 3): y - 3 = (1/2)(x + 2), so y = (1/2)x + 4. Equal slopes show p is parallel to l.
3. Perpendicular slope is -2. y - 3 = -2(x + 2), so n: y = -2x - 1. Solve (1/2)x = -2x - 1: (5/2)x = -1, x = -2/5. Then y = -1/5. Q = (-2/5, -1/5). Since slopes 1/2 and -2 are negative reciprocals, l is perpendicular to n.
4. 0.
5. Undefined.
6. (-3, 4).
7. Perpendicular. h is horizontal with slope 0; v is vertical with undefined slope. Horizontal and vertical lines meet at right angles. The negative-reciprocal rule does not apply because undefined is not a number.
8. Sample: l and n have nonzero negative-reciprocal slopes. h and v are perpendicular because one is horizontal and one is vertical; their special slopes are 0 and undefined.

Source credit: New York Next Generation Mathematics, GEO-G.GPE.5.c, “Apply properties of parallel and perpendicular lines to solve geometric problems.” https://lessonmakerpro.com/standards/ny-nextgen-math/geo-g-gpe-5-c