LESSON MAKER PRO

Slope Line Links

Explore why parallel and perpendicular lines have their slope relationships.

HIGH SCHOOL · GEO-G.GPE.5.a

GEO-G.GPE.5.a "Explore the proof for the relationship between slopes of parallel and perpendicular lines;"

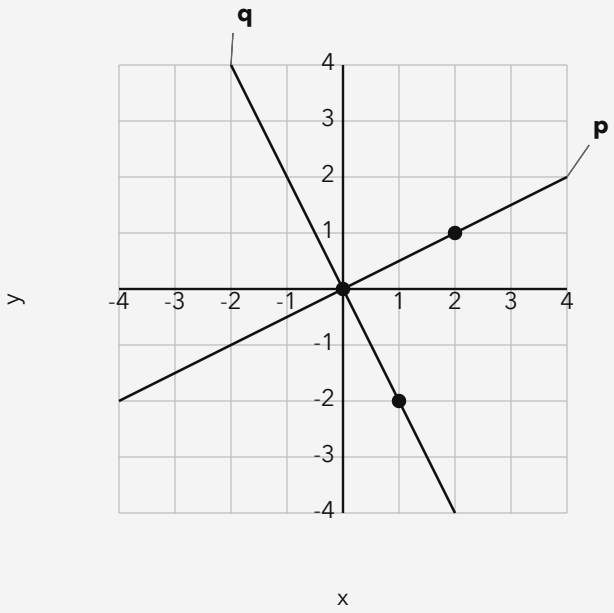
NAME _____ DATE _____

SLOPE RELATIONSHIPS

On a graph, slope is rise/run. Parallel nonvertical lines have equal slopes because they make the same rise and run. Perpendicular nonvertical lines have slopes with a product of -1, so the slopes are negative reciprocals. A horizontal line and a vertical line are also perpendicular.

WORKED EXAMPLE

Use the graph to find the slopes of p and q. How are the slopes related?



1. For p, rise 1 and run 2: m = 1/2.
2. For q, rise -2 and run 1: m = -2/1 = -2.
3. Multiply: (1/2)(-2) = -1.

Answer: p has slope 1/2 and q has slope -2. They are negative reciprocals, so the lines are perpendicular.

PRACTICE 4 problems

1 Line a has slope 7/9. What is the slope of a line parallel to a?

ANSWER _____

2 Line c has slope -8/3. What is the slope of a line perpendicular to c?

ANSWER _____

3 Lines have slopes -4/11 and 11/4. Are they parallel, perpendicular, or neither?

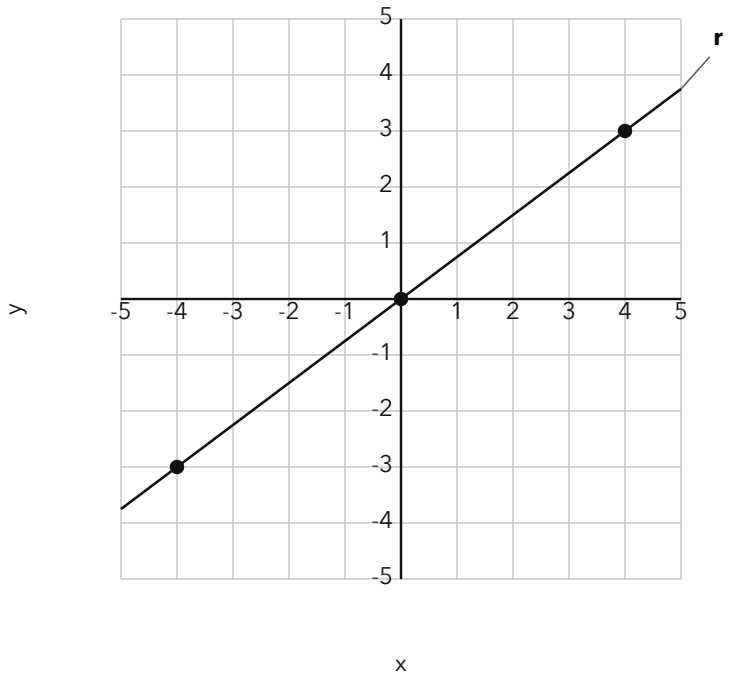
ANSWER _____

4 Find the slope of a line perpendicular to the line through (10, 6) and (14, 22).

ANSWER _____

APPLY IT Show your work

1 The grid shows edge r of a skate ramp. A handrail must be parallel to r. What slope should the handrail have?



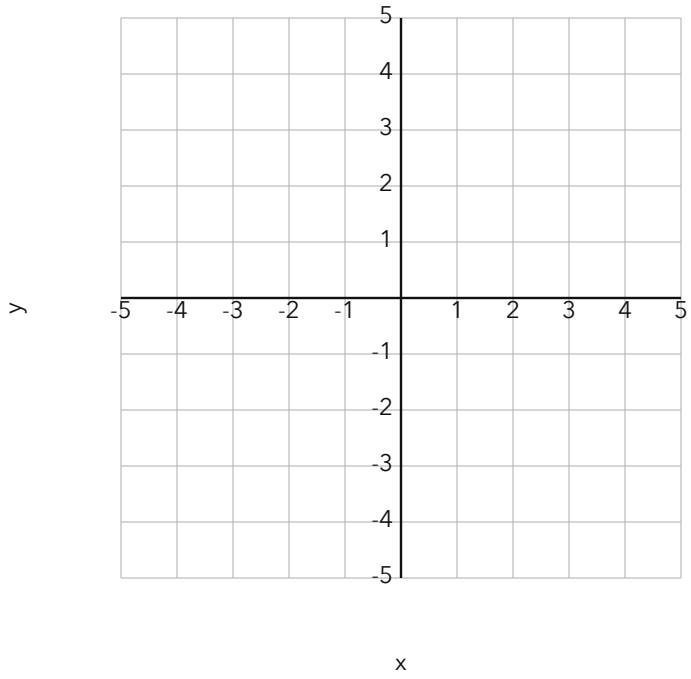
ANSWER _____

2 At a music festival, a lighting cable has slope 6/5. A brace must meet the cable at a right angle. What slope must the brace have?

WORK SPACE

ANSWER _____

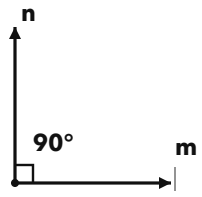
3 Proof exploration: draw OA from O(0,0) to A(4,2), and BC from B(0,2) to C(4,4). BC is OA translated up 2 units. Draw their rise/run triangles and explain why translation gives parallel directions and equal slopes. Rotate OA clockwise 90° about O: plot A′(2,-4), draw OA′ and find its slope. Explain why a quarter-turn makes perpendicular directions. Generalize: direction (a,b) has slope b/a and rotates to (b,-a). For nonzero a and b, derive the rotated slope and the product of the slopes. Explain separately what happens when b=0 or a=0.



ANSWER _____

CHALLENGE One step up

The figure shows perpendicular lines m and n. Line m has equation y = 7/12x + 5, and line n has equation y = kx - 7. Find k. Explain using the slopes.



WORK SPACE AND ANSWER

ANSWER KEY # Slope Line Links

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Line a has slope 7/9. What is the slope of a line parallel to a?	**7/9**
2	Line c has slope -8/3. What is the slope of a line perpendicular to c?	**3/8**
3	Lines have slopes -4/11 and 11/4. Are they parallel, perpendicular, or neither?	**perpendicular**
4	Find the slope of a line perpendicular to the line through (10, 6) and (14, 22).	**-1/4**

PART 2 · APPLY IT

1. **3/4** From the graph, r rises 3 units for a run of 4 units. A parallel handrail has the same slope.
2. **-5/6** A perpendicular slope is the negative reciprocal of 6/5. Reverse the numerator and denominator, then change the sign.
3. **The translated segments both have slope 2/4=1/2. The rotated segment has slope -4/2=-2. Generally m=b/a and rotated slope=-a/b, so their product is -1 for nonzero a and b. For b=0, horizontal rotates to vertical; for a=0, vertical rotates to horizontal.** Translation adds the same displacement to both endpoints, leaving rise and run unchanged. Rotation by 90° preserves length and turns direction by a right angle. The direction change (a,b)→(b,-a) changes rise/run from b/a to -a/b. Zero or undefined slopes require the horizontal/vertical exception.

CHALLENGE

k = -12/7 because (7/12)(-12/7) = -1.

Accept equivalent fractions and decimals where appropriate. For perpendicular lines, accept a correct negative-reciprocal explanation or a correct product of -1. Proof exploration: check the actual segments and rise/run triangles, B(0,2), C(4,4) and A′(2,-4), and a reasoned derivation from translation and quarter-turn. Quoting the negative-reciprocal rule alone is insufficient; check both zero-coordinate cases.