Perpendicular Lines and the Negative Reciprocal

Perpendicular lines cross at a right angle. Their slopes are negative reciprocals: flip the fraction and change the sign, because a quarter turn trades the rise and the run. Check: the product is -1.

Name _____ Date _____

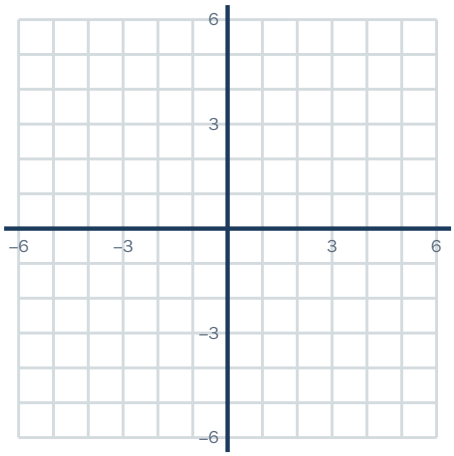
Words we use

say the math word, then the plain English

WORD	PLAIN ENGLISH	WHAT YOU DO
Perpendicular	Lines that cross at a right angle, a square corner.	Their slopes are negative reciprocals: multiply them and you get –1.
Right angle	A square corner, 90 degrees, like the corner of a page.	Where perpendicular lines meet.
Reciprocal	Flip the fraction: the top and bottom swap. The multiplicative inverse from Unit 1.	$\frac{2}{3}$ becomes $\frac{3}{2}$. A whole number 4 is $\frac{4}{1}$, so its reciprocal is $\frac{1}{4}$.
Negative reciprocal	Flip the fraction and change the sign.	The slope of a perpendicular line. $\frac{2}{3}$ becomes $-\frac{3}{2}$.
Product is –1	Two slopes that multiply to –1.	The quick check for perpendicular.
The special pair	A horizontal line (slope 0) and a vertical line (no slope).	They are perpendicular by sight. You cannot flip 0.

Part A The quarter turn

On the grid, draw the staircase for slope 3/4 from the origin (run 4, rise 3) and the line through it. Then turn the staircase a quarter turn (run becomes rise) and draw the perpendicular line. Label both slopes.



Original slope: _____

After the quarter turn, the rise is _____ and the run is _____.

Perpendicular slope: _____

Check: _____ × _____ = _____

Part B Flip and change the sign

Write the perpendicular slope and show the product check.

SLOPE	RECIPROCAL (FLIP)	NEGATIVE RECIPROCAL	CHECK: PRODUCT

–3

Part C Perpendicular or not?

Multiply the slopes. Write yes (product –1) or no.

–7/2

PAIR	SLOPES	PRODUCT	PERPENDICULAR?
y = 4x + 1 and y = –1/4 x + 9			
1			
y = 2/3 x and y = 3/2 x + 1			

y = –x + 5 and y = x – 2			
y = 5 and x = –1			

Part D Write the perpendicular line

New m is the negative reciprocal. Put the point in, solve for b, write y = mx + b, check the product.

1. Perpendicular to y = 2x – 7 through (4, 1)

2. Perpendicular to y = –3/4 x + 2 through (3, 0)

3. Perpendicular to 3x + y = 5 through (–3, 2)

Part E In your own words

1. Why does a quarter turn make the rise and the run trade places, and why does the sign change?

2. Why do perpendicular slopes multiply to –1? (Think about the multiplicative inverse from Unit 1.)

3. Which pair of lines can the flip rule not handle, and how do you know they are perpendicular anyway?

Part F Exit ticket

1. Perpendicular slope to –2/5, with the check:

2. Line perpendicular to $y = 3x + 2$ through (3, 4):

Answer key

Part A. Original 3/4. After the turn: rise 4, run 3, leaning the other way. Perpendicular slope –4/3. Check: 3/4 × (–4/3) = –1.

Part B. 2/5: 5/2, –5/2, –1. –3: –1/3, 1/3, –1. 1/6: 6, –6, –1. –7/2: –2/7, 2/7, –1. 1: 1, –1, –1.

Part C. 4 and –1/4: –1, yes. 2/3 and 3/2: 1, no. –1 and 1: –1, yes. 0 and undefined: no product; yes by sight (horizontal and vertical).

Part D. 1. $y = -1/2\,x + 3$. 2. $y = 4/3\,x - 4$. 3. $y = 1/3\,x + 3$ (given line is $y = -3x + 5$).

Part E. 1. The staircase turns with the line: sideways becomes up, up becomes sideways; the line leans the other way, so the sign flips. 2. A fraction times its reciprocal is 1; changing one sign makes it –1. 3. Horizontal and vertical: 0 cannot be flipped; flat meets straight up and down at a square corner.

Part F. 1. 5/2; $-2/5 \times 5/2 = -1$. 2. $y = -1/3\,x + 5$.