MATHEMATICS · GRADES 10-12

Parallel and perpendicular lines

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how builders check that walls meet at square corners and that opposite sides of a room stay the same distance apart. A room with corners that are not square will show it when the flooring goes in, and walls that are not parallel will make the room wider at one end than the other. A carpenter checks both before a single board is cut, because fixing it later costs far more. It is the same check a tiler makes before laying the first row, and a framer makes before the walls go up.



Rule

Parallel lines have the same slope.

Perpendicular lines have slopes that are negative reciprocals of each other, so $m_1 \times m_2 = -1$.

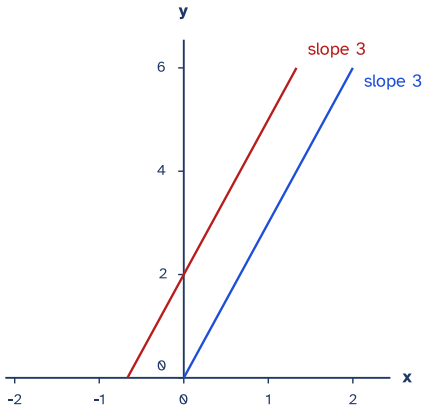
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Worked examples

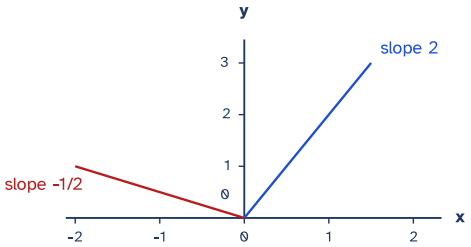
EXAMPLE 1

Q A line is parallel to y = 5x – 1. What is its slope?

Parallel, equal slopes



Perpendicular, negative reciprocals



SOLUTION

Lines running parallel to each other have matching slopes. The line y = 5x – 1 has slope 5, so any line parallel to it has slope 5 too.

The slope is 5.

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EXAMPLE 2

Q **Write the equation of the line perpendicular to $y = 2x + 1$ that passes through $(0, 3)$.**

SOLUTION

Perpendicular slopes are negative reciprocals: flip the slope and change the sign. The slope of $y = 2x + 1$ is 2, so the perpendicular slope is $-1/2$.

$$y = \frac{-1}{2}x + 3$$

The line passes through $(0, 3)$, so its y-intercept is 3.

Practice questions

1 **What is the slope of a line parallel to $y = 6x + 2$?**

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2 **A ladder leans against a wall, perpendicular to a ramp that follows $y = 5x - 1$. What is the slope of the ladder?**

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3 A fence has two rails with equations $y = 2x + 1$ and $y = 2x + 3$. Are the rails parallel?

- A Yes
- B No

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4 A roof follows $y = 3x$ and a wall follows $y = \frac{-x}{3}$. Are the roof and the wall perpendicular?

- A Yes
- B No

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5 What is the slope of a line perpendicular to $y = 4x$?

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6 Write the equation of the line parallel to $y = -2x + 7$ that passes through $(0, 1)$.

- A $y = -2x + 1$
- B $y = -2x - 1$
- C $y = 2x + 1$
- D $y = -2x + 7$

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7 Two lines have equations $y = x + 1$ and $y = -x + 2$. Are they parallel, perpendicular, or neither?

- A Parallel
- B Perpendicular
- C Neither

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8

A vertical line has what slope?

A 0

B Undefined

C 1

D -1

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9

A line passes through (0, 0) and (2, 6). What is the slope of a line parallel to it?

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10 **Two streets follow $y = x + 2$ and $y = x - 5$. Do the streets ever meet?**

- **A** No, they are parallel
- **B** Yes, they meet
- **C** No, they are perpendicular
- **D** Yes, they meet at $(0, 2)$

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ANSWER KEY

1. 6

2. $\frac{-1}{5}$

3. Yes

4. Yes

5. $\frac{-1}{4}$

6. $y = -2x + 1$

7. Perpendicular

8. Undefined

9. 3

10. No, they are parallel

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