Parallel and Perpendicular Lines

Name: _____ Date: _____ Score: _____ / 26

Quick Review

Two lines are **parallel** if they have the *same slope* — they go in the same direction and never meet. (Different y-intercepts, though, or they'd be the same line.) Two lines are **perpendicular** if their slopes are **negative reciprocals** — they multiply to -1. If one slope is $\frac{2}{3}$, the perpendicular slope is $-\frac{3}{2}$. Flip the fraction and negate. Horizontal lines ($y = k$) are perpendicular to vertical lines ($x = h$) — a special case. To **write a line parallel/perpendicular to a given line through a point**: figure out the new slope (same or negative reciprocal), then use point-slope form.

PRACTICE

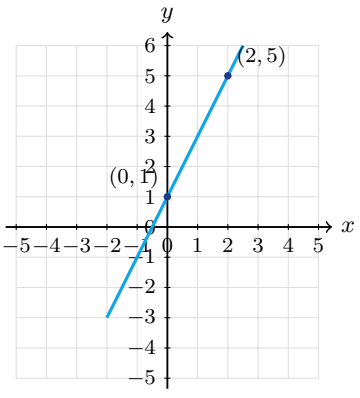
Find slopes or write equations of parallel/perpendicular lines.

1. What slope must a line have to be parallel to $y = 2x + 1$? _____
2. Perpendicular to $y = 2x + 1$ _____
3. What slope must a line have to be parallel to $y = -3x + 4$? _____
4. Perpendicular to $y = -3x + 4$ _____
5. What slope is parallel to the line $y = \frac{1}{2}x$? _____
6. What slope is perpendicular to the line $y = \frac{1}{2}x$? _____
7. Parallel through $(2, 5)$ to $y = 3x + 1$ _____
8. Perp. through $(2, 5)$ to $y = 3x + 1$ _____
9. Perp. to horizontal _____
10. Are $y = 2x + 1$ and $y = 2x - 5$ parallel? _____
11. Are $y = 3x$ and $y = -\frac{1}{3}x$ perp.? _____
12. What slope is perpendicular to $y = -\frac{2}{5}x$? _____
13. Write the equation of the line through the origin that is parallel to $y = 4x - 2$. _____
14. Perp. to $y = -x + 7$ _____
15. Are $y = \frac{2}{3}x + 1$ and $y = -\frac{3}{2}x + 1$ perp.? _____
16. Are $y = 2x$ and $y = 2x + 5$ same? _____
17. Slope perp. to $2x + 3y = 6$ _____
18. Perp. through $(0, 0)$ to $y = 5x$ _____
19. Write the line through $(-1, 4)$ that is parallel to $y = x - 3$. _____
20. Perp. through $(4, -2)$ to $y = 2x$ _____

VISUAL PRACTICE

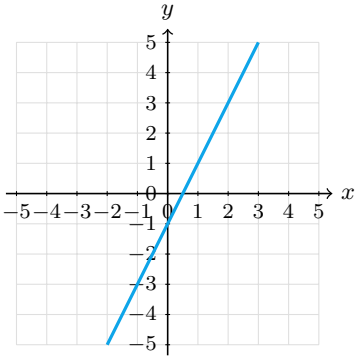
Use the graph, table, chart, or diagram to answer the question.

21. Find the slope of a line parallel to the graphed line.



Answer: _____

22. The graphed line has slope 2. What is the slope of a perpendicular line?



Answer: _____

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Word Problems

23. A street runs along the line $y = \frac{2}{3}x + 1$. A perpendicular cross street passes through $(6, 5)$. Find its equation.

Model: _____ **Answer:** _____

24. Two roads are modeled by lines with slopes $\frac{3}{4}$ and $-\frac{4}{3}$. Determine whether the roads are perpendicular and justify your answer.

Model: _____ **Answer:** _____

25. A roof beam runs along $y = -\frac{1}{2}x + 10$. A support beam runs perpendicular through the point $(4, 8)$. Write the support beam's equation.

Model: _____ **Answer:** _____

26. Two train tracks must be parallel for safety. Track A has equation $y = 4x - 7$. Track B passes through $(0, 3)$. Write Track B's equation.

Model: _____ **Answer:** _____

Answer Keys

1. $m = 2$
2. $m = -\frac{1}{2}$
3. $m = -3$
4. $m = \frac{1}{3}$
5. $m = \frac{1}{2}$
6. $m = -2$
7. $y = 3x - 1$
8. $y = -\frac{1}{3}x + \frac{17}{3}$
9. vertical
10. yes
11. yes
12. $m = \frac{5}{2}$
13. $y = 4x$
14. $m = 1$
15. yes
16. no, parallel
17. $m = \frac{3}{2}$
18. $y = -\frac{1}{5}x$
19. $y = x + 5$
20. $y = -\frac{1}{2}x$
21. 2
22. $-\frac{1}{2}$
23. $y = -\frac{3}{2}x + 14$
24. yes
25. $y = 2x$
26. $y = 4x + 3$

Step-by-Step Tutor Notes

1. Parallel lines have the same slope. The given line has slope 2, so the parallel line also has slope 2.
2. Focus on the main idea of the problem, then simplify carefully. Negative reciprocal of 2. So the answer is $m = -\frac{1}{2}$.
3. Read the slope from slope-intercept form: $m = -3$. A parallel line keeps that same slope.
4. Use the clue in the question first, then let the arithmetic finish the job. Flip -3 to $-\frac{1}{3}$, negate to $\frac{1}{3}$. So the answer is $m = \frac{1}{3}$.
5. Compare the change in output to the change in input, because slope is a rate of change. Parallel lines match slopes, so the slope stays $\frac{1}{2}$. So the requested value is $m = \frac{1}{2}$.
6. A perpendicular slope is the negative reciprocal. Flip $\frac{1}{2}$ to 2 and change the sign to get -2.
7. Read the table by matching the correct row and column first, then use the count or total that fits the question. Same slope 3. $5 = 3(2) + b \Rightarrow b = -1$. This gives $y = 3x - 1$.
8. Use the labels on the display first; they tell you which count or total belongs in the answer. Slope $-\frac{1}{3}$. $5 = -\frac{1}{3}(2) + b \Rightarrow b = \frac{17}{3}$. This gives $y = -\frac{1}{3}x + \frac{17}{3}$.
9. Think of slope as the amount the output changes for each 1-unit change in the input. Horizontal ($m = 0$) is perpendicular to vertical (undefined slope). So the requested value is vertical.
10. Think of slope as the amount the output changes for each 1-unit change in the input. Same slope, different y-intercepts. So the requested value is yes.
11. This is a good place to slow down, check the notation, and simplify cleanly. $3 \cdot (-\frac{1}{3}) = -1$. So the answer is yes.
12. The original slope is $-\frac{2}{5}$. Flip the fraction and change the sign, so the perpendicular slope is $\frac{5}{2}$.
13. A parallel line has the same slope, 4. Passing through the origin means $b = 0$, so the equation is $y = 4x$.
14. Compare the change in output to the change in input, because slope is a rate of change. Slope of original is -1. Negative reciprocal: 1. So the requested value is $m = 1$.
15. Start with the definition the problem is testing, then apply it directly. $\frac{2}{3} \cdot (-\frac{3}{2}) = -1$. So the answer is yes.
16. Compare the change in output to the change in input, because slope is a rate of change. Same slope but different intercepts — parallel but distinct. So the requested value is no, parallel.
17. Line up the two changes first; that keeps the rate from getting mixed up. Convert: $y = -\frac{2}{3}x + 2$. Perp slope: $\frac{3}{2}$. So the requested value is $m = \frac{3}{2}$.
18. Compare the change in output to the change in input, because slope is a rate of change. Slope $-\frac{1}{5}$, through origin. So the requested value is $y = -\frac{1}{5}x$.
19. The given line has slope 1, so the parallel line also has slope 1. Use $(-1, 4)$ in $y = x + b$: $4 = -1 + b$, so $b = 5$.
20. Use the labels on the display first; they tell you which count or total belongs in the answer. $m = -\frac{1}{2}$. $-2 = -\frac{1}{2}(4) + b = -2 + b \Rightarrow b = 0$. This gives $y = -\frac{1}{2}x$.
21. Compare the change in output to the change in input, because slope is a rate of change. Parallel lines have the same slope, so the parallel slope is 2. So the requested value is 2.
22. Think of slope as the amount the output changes for each 1-unit change in the input. Perpendicular slopes are opposite reciprocals. The opposite reciprocal of 2 is $-\frac{1}{2}$. So the requested value is $-\frac{1}{2}$.
23. Perp slope: $-\frac{3}{2}$. Through $(6, 5)$: $5 = -\frac{3}{2}(6) + b = -9 + b \Rightarrow b = 14$.
24. Set up the model from the story, then calculate carefully. $\frac{3}{4} \cdot (-\frac{4}{3}) = -1$. They meet at a right angle.
25. Read the table by matching the correct row and column first, then use the count or total that fits the question. Perp slope: 2. Through $(4, 8)$: $8 = 2(4) + b \Rightarrow b = 0$. This gives $y = 2x$.
26. Line up the two changes first; that keeps the rate from getting mixed up. Same slope: $m = 4$. Through $(0, 3)$: $b = 3$. So the requested value is $y = 4x + 3$.

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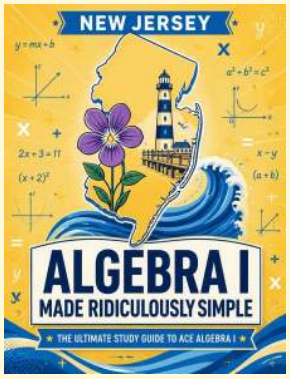

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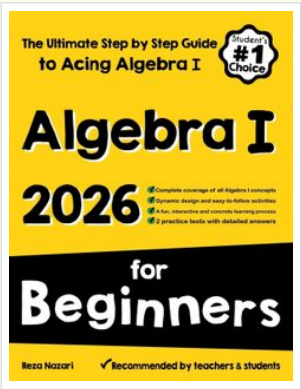

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