Parallel and Perpendicular Lines

Name: _____	Date: _____	Score: _____ / 24

Quick Review

Two lines are **parallel** when they have the *same slope* — they run side by side and never meet. Two lines are **perpendicular** when they cross at a right angle, and their slopes are **negative reciprocals**: flip the fraction and change the sign. For example, the perpendicular partner of slope 2 is $-\frac{1}{2}$, and the partner of $-\frac{3}{4}$ is $\frac{4}{3}$. A quick test: two slopes are perpendicular exactly when their *product is* -1.

◇ **Example:** A line has slope 4. What is the slope of a line perpendicular to it?

⇒ Perpendicular lines meet at a right angle, and the rule for their slopes is "negative reciprocal." That's a two-part instruction. First, take the *reciprocal* — flip 4 (which is $\frac{4}{1}$) into $\frac{1}{4}$. Second, change the *sign* — since 4 was positive, the answer becomes negative: $-\frac{1}{4}$. A good check: multiply the two slopes together, $4 \times \left(-\frac{1}{4}\right) = -1$. That product of -1 confirms they really are perpendicular.

Answer: $-\frac{1}{4}$

PRACTICE

Find the requested slope, or decide the relationship between the lines.

1. Parallel to slope 3 _____
2. Parallel to slope -5 _____
3. Parallel to slope $\frac{2}{7}$ _____
4. Perpendicular to slope 2 _____
5. Perpendicular to slope 5 _____
6. Perpendicular to slope -3 _____
7. Perpendicular to slope $\frac{1}{4}$ _____
8. Perpendicular to slope $\frac{3}{5}$ _____
9. Perpendicular to slope $-\frac{2}{3}$ _____
10. Perpendicular to slope 1 _____
11. $y = 2x + 1$ and $y = 2x - 4$ _____
12. $y = 3x$ and $y = -\frac{1}{3}x + 2$ _____
13. $y = 4x + 1$ and $y = 5x - 2$ _____
14. $y = -x + 6$ and $y = x - 3$ _____
15. $y = \frac{1}{2}x$ and $y = \frac{1}{2}x + 7$ _____
16. Slope $6 \cdot$ slope $-\frac{1}{6} = ?$ _____
17. Parallel to $y = 7x - 2$, slope $= ?$ _____
18. Perpendicular to $y = -2x + 9$ _____
19. $y = -\frac{4}{5}x$ and $y = \frac{5}{4}x$ _____
20. $y = 8x + 1$ and $y = 8x + 1$ _____

Word Problems

21. A street runs along the line $y = \frac{2}{3}x + 1$. A new street is built parallel to it. What slope must the new street have? _____

22. A ramp follows the line $y = 5x$. A support beam must be perpendicular to the ramp. What slope should the beam have? _____

23. Two roads are described by $y = -3x + 4$ and $y = \frac{1}{3}x - 1$. Do they meet at a right angle? _____

24. A fence runs along $y = 4x - 2$. A gardener wants a path parallel to the fence passing through a different spot. What slope should the path have? _____

Answer Keys

1. $\boxed{3}$
2. $\boxed{-5}$
3. $\boxed{\frac{2}{7}}$
4. $\boxed{-\frac{1}{2}}$
5. $\boxed{-\frac{1}{5}}$
6. $\boxed{\frac{1}{3}}$
7. $\boxed{-4}$
8. $\boxed{-\frac{5}{3}}$
9. $\boxed{\frac{3}{2}}$
10. $\boxed{-1}$
11. $\boxed{\text{parallel}}$
12. $\boxed{\text{perpendicular}}$
13. $\boxed{\text{neither}}$
14. $\boxed{\text{perpendicular}}$
15. $\boxed{\text{parallel}}$
16. $\boxed{-1}$
17. $\boxed{7}$
18. $\boxed{\frac{1}{2}}$
19. $\boxed{\text{perpendicular}}$
20. $\boxed{\text{same line}}$
21. $\boxed{\frac{2}{3}}$
22. $\boxed{-\frac{1}{5}}$
23. $\boxed{\text{yes}}$
24. $\boxed{4}$

Step-by-Step Explanations

1. Parallel lines share the same slope, so the slope is 3.
2. Parallel means equal slopes, so it stays -5.
3. A parallel line keeps the slope $\frac{2}{7}$.
4. Flip 2 to $\frac{1}{2}$ and change the sign: $-\frac{1}{2}$.
5. Flip and negate: $-\frac{1}{5}$.
6. Flip -3 to $-\frac{1}{3}$ and change the sign: $\frac{1}{3}$.
7. Flip $\frac{1}{4}$ to 4 and negate: -4.
8. Flip $\frac{3}{5}$ to $\frac{5}{3}$ and negate: $-\frac{5}{3}$.
9. Flip $-\frac{2}{3}$ to $-\frac{3}{2}$ and change sign: $\frac{3}{2}$.
10. Flip 1 to 1 and negate: -1.
11. Both have slope 2, so the lines are parallel.
12. Slopes 3 and $-\frac{1}{3}$ are negative reciprocals — perpendicular.
13. Slopes 4 and 5 are not equal and not negative reciprocals.
14. Slopes -1 and 1 multiply to -1, so they are perpendicular.
15. Both slopes are $\frac{1}{2}$, so they are parallel.
16. $6 \times \left(-\frac{1}{6}\right) = -1$, confirming perpendicular lines.
17. Read the slope from $y = 7x - 2$: it's 7, and a parallel line matches it.
18. Slope is -2; flip to $-\frac{1}{2}$ and negate: $\frac{1}{2}$.
19. $-\frac{4}{5}$ and $\frac{5}{4}$ are negative reciprocals: perpendicular.
20. Identical slope *and* intercept — they are the same line.
21. Parallel streets have equal slopes, so the new street also has slope $\frac{2}{3}$.
22. The perpendicular slope is the negative reciprocal of 5, which is $-\frac{1}{5}$.
23. The slopes are -3 and $\frac{1}{3}$. Their product is $-3 \times \frac{1}{3} = -1$, so the roads are perpendicular.
24. Parallel lines share a slope, so the path must have slope 4, the same as the fence.

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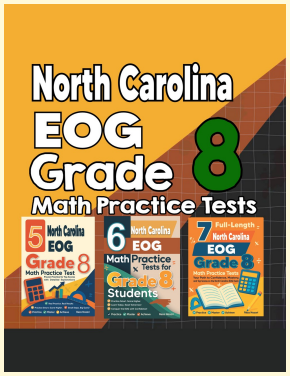

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