

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, $4 \times (-\frac{1}{4}) = -1$. 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.

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

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| <ol style="list-style-type: none"> 1. <input type="text" value="3"/> 2. <input type="text" value="-5"/> 3. <input type="text" value="2/7"/> 4. <input type="text" value="-1/2"/> 5. <input type="text" value="-1/5"/> 6. <input type="text" value="1/3"/> 7. <input type="text" value="-4"/> 8. <input type="text" value="-5/3"/> 9. <input type="text" value="3/2"/> 10. <input type="text" value="-1"/> 11. <input type="text" value="parallel"/> 12. <input type="text" value="perpendicular"/> | <ol style="list-style-type: none"> 13. <input type="text" value="neither"/> 14. <input type="text" value="perpendicular"/> 15. <input type="text" value="parallel"/> 16. <input type="text" value="-1"/> 17. <input type="text" value="7"/> 18. <input type="text" value="1/2"/> 19. <input type="text" value="perpendicular"/> 20. <input type="text" value="same line"/> 21. <input type="text" value="2/3"/> 22. <input type="text" value="-1/5"/> 23. <input type="text" value="yes"/> 24. <input type="text" value="4"/> |
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Step-by-Step Explanations

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| <ol style="list-style-type: none"> 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. | <ol style="list-style-type: none"> 14. Slopes -1 and 1 multiply to -1, so they are perpendicular. 15. Both slopes are $\frac{1}{2}$, so they are parallel. 16. $6 \times (-\frac{1}{6}) = -1$, 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 <i>and</i> 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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