

# Parallel and Perpendicular Lines

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Score: \_\_\_\_\_ / 24

## Q 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.

- |                                          |       |                                                   |       |
|------------------------------------------|-------|---------------------------------------------------|-------|
| 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

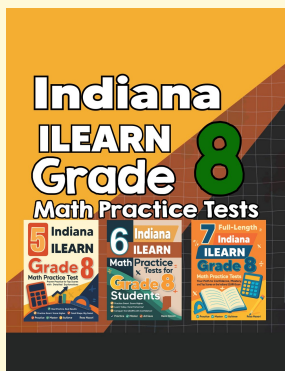
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| <ol style="list-style-type: none"> <li>1. <input type="text" value="3"/></li> <li>2. <input type="text" value="-5"/></li> <li>3. <input type="text" value="2/7"/></li> <li>4. <input type="text" value="-1/2"/></li> <li>5. <input type="text" value="-1/5"/>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

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| <ol style="list-style-type: none"> <li>1. Parallel lines share the same slope, so the slope is 3.</li> <li>2. Parallel means equal slopes, so it stays <math>-5</math>.</li> <li>3. A parallel line keeps the slope <math>\frac{2}{7}</math>.</li> <li>4. Flip 2 to <math>\frac{1}{2}</math> and change the sign: <math>-\frac{1}{2}</math>.</li> <li>5. Flip and negate: <math>-\frac{1}{5}</math>.</li> <li>6. Flip <math>-3</math> to <math>-\frac{1}{3}</math> and change the sign: <math>\frac{1}{3}</math>.</li> <li>7. Flip <math>\frac{1}{4}</math> to 4 and negate: <math>-4</math>.</li> <li>8. Flip <math>\frac{3}{5}</math> to <math>\frac{5}{3}</math> and negate: <math>-\frac{5}{3}</math>.</li> <li>9. Flip <math>-\frac{2}{3}</math> to <math>-\frac{3}{2}</math> and change sign: <math>\frac{3}{2}</math>.</li> <li>10. Flip 1 to 1 and negate: <math>-1</math>.</li> <li>11. Both have slope 2, so the lines are parallel.</li> <li>12. Slopes 3 and <math>-\frac{1}{3}</math> are negative reciprocals — perpendicular.</li> <li>13. Slopes 4 and 5 are not equal and not negative reciprocals.</li> </ol> | <ol style="list-style-type: none"> <li>14. Slopes <math>-1</math> and 1 multiply to <math>-1</math>, so they are perpendicular.</li> <li>15. Both slopes are <math>\frac{1}{2}</math>, so they are parallel.</li> <li>16. <math>6 \times (-\frac{1}{6}) = -1</math>, confirming perpendicular lines.</li> <li>17. Read the slope from <math>y = 7x - 2</math>: it's 7, and a parallel line matches it.</li> <li>18. Slope is <math>-2</math>; flip to <math>-\frac{1}{2}</math> and negate: <math>\frac{1}{2}</math>.</li> <li>19. <math>-\frac{4}{5}</math> and <math>\frac{5}{4}</math> are negative reciprocals: perpendicular.</li> <li>20. Identical slope <i>and</i> intercept — they are the same line.</li> <li>21. Parallel streets have equal slopes, so the new street also has slope <math>\frac{2}{3}</math>.</li> <li>22. The perpendicular slope is the negative reciprocal of 5, which is <math>-\frac{1}{5}</math>.</li> <li>23. The slopes are <math>-3</math> and <math>\frac{1}{3}</math>. Their product is <math>-3 \times \frac{1}{3} = -1</math>, so the roads are perpendicular.</li> <li>24. Parallel lines share a slope, so the path must have slope 4, the same as the fence.</li> </ol> |
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