

# Slope as a Rate of Change

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Score: \_\_\_\_\_ / 24

## Q Quick Review

**Slope** measures how steep a line is — how fast  $y$  changes as  $x$  changes. We find it with the formula  $m = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$ , the change in  $y$  divided by the change in  $x$ . A *positive* slope climbs to the right; a *negative* slope falls. A **horizontal** line has slope 0, and a **vertical** line has an undefined slope. In real life, slope is a **rate of change** — like miles per hour or dollars per day.

◇ **Example:** Find the slope of the line through (2, 3) and (6, 11).

⇒ Slope is just rise over run, so we track how much  $y$  and  $x$  each change between the two points. The change in  $y$  is  $11 - 3 = 8$  (that's the rise), and the change in  $x$  is  $6 - 2 = 4$  (that's the run). Now divide:  $m = \frac{8}{4} = 2$ . A slope of 2 means every time  $x$  goes up by 1,  $y$  goes up by 2. Tip: pick a starting point and subtract in the *same order* for both top and bottom.

**Answer:**  $m = 2$

## PRACTICE

Find the slope of the line through each pair of points.

- |                         |       |                         |       |
|-------------------------|-------|-------------------------|-------|
| 1. (0, 0) and (1, 5)    | _____ | 11. (-2, -3) and (2, 5) | _____ |
| 2. (1, 2) and (3, 8)    | _____ | 12. (0, 0) and (6, 4)   | _____ |
| 3. (2, 1) and (5, 7)    | _____ | 13. (1, 1) and (5, 3)   | _____ |
| 4. (0, 4) and (4, 12)   | _____ | 14. (2, 7) and (8, 4)   | _____ |
| 5. (1, 1) and (4, 10)   | _____ | 15. (-3, 4) and (3, 4)  | _____ |
| 6. (3, 5) and (7, 5)    | _____ | 16. (5, -2) and (5, 9)  | _____ |
| 7. (2, 8) and (2, 1)    | _____ | 17. (-4, 1) and (0, 9)  | _____ |
| 8. (0, 6) and (3, 0)    | _____ | 18. (1, -5) and (4, 4)  | _____ |
| 9. (1, 9) and (4, 3)    | _____ | 19. (0, 10) and (5, 0)  | _____ |
| 10. (-1, 2) and (3, 10) | _____ | 20. (-2, 6) and (4, -3) | _____ |

### ◆ Word Problems

21. A plant was 4 cm tall on day 2 and 16 cm tall on day 8. Find the growth rate (slope) in centimeters per day. \_\_\_\_\_
22. A candle is 20 cm tall after burning for 1 hour and 8 cm tall after 5 hours. Find the slope and explain what it means. \_\_\_\_\_
23. A taxi charges a flat fee plus a per-mile rate. The total is \$8 at 2 miles and \$20 at 8 miles. Find the per-mile rate (slope). \_\_\_\_\_
24. A savings account had \$150 in week 0 and \$390 in week 8, growing by the same amount each week. Find the weekly savings rate. \_\_\_\_\_



## Answer Keys

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| <ol style="list-style-type: none"> <li>1. <math>m = 5</math></li> <li>2. <math>m = 3</math></li> <li>3. <math>m = 2</math></li> <li>4. <math>m = 2</math></li> <li>5. <math>m = 3</math></li> <li>6. <math>m = 0</math></li> <li>7. undefined</li> <li>8. <math>m = -2</math></li> <li>9. <math>m = -2</math></li> <li>10. <math>m = 2</math></li> <li>11. <math>m = 2</math></li> <li>12. <math>m = \frac{2}{3}</math></li> </ol> | <ol style="list-style-type: none"> <li>13. <math>m = \frac{1}{2}</math></li> <li>14. <math>m = -\frac{1}{2}</math></li> <li>15. <math>m = 0</math></li> <li>16. undefined</li> <li>17. <math>m = 2</math></li> <li>18. <math>m = 3</math></li> <li>19. <math>m = -2</math></li> <li>20. <math>m = -\frac{3}{2}</math></li> <li>21. 2 cm per day</li> <li>22. <math>m = -3</math> cm per hour</li> <li>23. \$2 per mile</li> <li>24. \$30 per week</li> </ol> |
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### Step-by-Step Explanations

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| <ol style="list-style-type: none"> <li>1. Rise = <math>5 - 0 = 5</math>, run = <math>1 - 0 = 1</math>, so <math>m = \frac{5}{1} = 5</math>.</li> <li>2. Rise = <math>8 - 2 = 6</math>, run = <math>3 - 1 = 2</math>, so <math>m = \frac{6}{2} = 3</math>.</li> <li>3. Rise = <math>7 - 1 = 6</math>, run = <math>5 - 2 = 3</math>, so <math>m = \frac{6}{3} = 2</math>.</li> <li>4. Rise = <math>12 - 4 = 8</math>, run = <math>4 - 0 = 4</math>, so <math>m = 2</math>.</li> <li>5. Rise = <math>10 - 1 = 9</math>, run = <math>4 - 1 = 3</math>, so <math>m = 3</math>.</li> <li>6. The <math>y</math>-values are equal, so rise = 0. A flat line has slope 0.</li> <li>7. The <math>x</math>-values are equal, so the run is 0. Dividing by 0 is undefined.</li> <li>8. Rise = <math>0 - 6 = -6</math>, run = <math>3 - 0 = 3</math>, so <math>m = -2</math> (line falls).</li> <li>9. Rise = <math>3 - 9 = -6</math>, run = <math>4 - 1 = 3</math>, so <math>m = -2</math>.</li> <li>10. Rise = <math>10 - 2 = 8</math>, run = <math>3 - (-1) = 4</math>, so <math>m = 2</math>.</li> <li>11. Rise = <math>5 - (-3) = 8</math>, run = <math>2 - (-2) = 4</math>, so <math>m = 2</math>.</li> <li>12. Rise = 4, run = 6, so <math>m = \frac{4}{6} = \frac{2}{3}</math>.</li> <li>13. Rise = <math>3 - 1 = 2</math>, run = <math>5 - 1 = 4</math>, so <math>m = \frac{2}{4} = \frac{1}{2}</math>.</li> <li>14. Rise = <math>4 - 7 = -3</math>, run = <math>8 - 2 = 6</math>, so <math>m = -\frac{1}{2}</math>.</li> </ol> | <ol style="list-style-type: none"> <li>15. Same <math>y</math>-value both times, so rise = 0 and <math>m = 0</math>.</li> <li>16. Same <math>x</math>-value means run = 0; the slope is undefined (vertical).</li> <li>17. Rise = <math>9 - 1 = 8</math>, run = <math>0 - (-4) = 4</math>, so <math>m = 2</math>.</li> <li>18. Rise = <math>4 - (-5) = 9</math>, run = <math>4 - 1 = 3</math>, so <math>m = 3</math>.</li> <li>19. Rise = <math>0 - 10 = -10</math>, run = <math>5 - 0 = 5</math>, so <math>m = -2</math>.</li> <li>20. Rise = <math>-3 - 6 = -9</math>, run = <math>4 - (-2) = 6</math>, so <math>m = -\frac{9}{6} = -\frac{3}{2}</math>.</li> <li>21. Rise = <math>16 - 4 = 12</math> cm, run = <math>8 - 2 = 6</math> days, so the rate is <math>\frac{12}{6} = 2</math> cm per day.</li> <li>22. Rise = <math>8 - 20 = -12</math>, run = <math>5 - 1 = 4</math>, so <math>m = -3</math>. The candle shortens by 3 cm each hour.</li> <li>23. Rise = <math>20 - 8 = 12</math> dollars, run = <math>8 - 2 = 6</math> miles, so the rate is <math>\frac{12}{6} = \\$2</math> per mile.</li> <li>24. Rise = <math>390 - 150 = 240</math> dollars, run = <math>8 - 0 = 8</math> weeks, so <math>\frac{240}{8} = \\$30</math> per week.</li> </ol> |
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