

# Slope and Rate of Change

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Score: \_\_\_\_\_ / 26

## Q Quick Review

**Slope** measures how steep a line is — how much  $y$  changes for every 1 unit of  $x$ . The formula:  $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\text{rise}}{\text{run}}$ . Positive slope goes *up* left-to-right; negative slope goes *down*; zero slope is *horizontal*; undefined slope is *vertical* (you'd be dividing by zero). Slope is the same as **rate of change** — in a word problem, “\$5 per hour” is a slope of 5 (dollars per hour). The trick when computing: keep the order of subtraction consistent. If  $y_2$  comes from the second point on top,  $x_2$  must come from the second point on bottom.

## PRACTICE

Find the slope.

- |                      |       |  |       |
|----------------------|-------|--|-------|
| 1. (1, 2), (3, 8)    | _____ | 11. (2, 3), (2, 9)   | _____ |
| 2. (0, 5), (4, 13)   | _____ | 12. (-1, -3), (2, 3)   | _____ |
| 3. (-1, 4), (2, -2)  | _____ | 13. Rise 10, run 4   | _____ |
| 4. (3, 7), (3, -1)   | _____ | 14. Up 6, right 3  | _____ |
| 5. (-2, 5), (4, 5)   | _____ | 15. (7, 2), (10, 11)   | _____ |
| 6. (0, 0), (5, 15)   | _____ | 16. Table: $x = 1 \rightarrow y = 5, x = 3 \rightarrow y = 11$ | _____ |
| 7. (1, 1), (4, 7)    | _____ | 17. (0, 8), (4, 0)   | _____ |
| 8. (-3, -2), (1, 6)  | _____ | 18. (-4, 1), (4, 5)  | _____ |
| 9. (5, -1), (2, 8)   | _____ | 19. (6, -2), (9, -2)   | _____ |
| 10. (0, -4), (6, -4) | _____ | 20. (1, 10), (5, 2)  | _____ |

## ◆ VISUAL PRACTICE

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

21. Use the table to find the rate of change.

hours	0	1	2	3
miles	0	3	6	9

Answer: \_\_\_\_\_

22. Find the rate of change of the graphed line.



Answer: \_\_\_\_\_



◆ Word Problems

23. A car drives 180 miles in 3 hours at a steady speed. What's the speed (slope)?

Model: \_\_\_\_\_

Answer: \_\_\_\_\_

24. A science class measures a plant and finds that it grew 2 cm over 5 days. What is the plant's average growth rate in centimeters per day?

Model: \_\_\_\_\_

Answer: \_\_\_\_\_

25. A pool starts with 1000 gal and drops to 760 gal after 4 hours of draining. Find the drain rate.

Model: \_\_\_\_\_

Answer: \_\_\_\_\_

26. A roof rises 4 feet over a horizontal run of 12 feet. Find the slope of the roof and connect it to the roof's pitch.

Model: \_\_\_\_\_

Answer: \_\_\_\_\_



## Answer Keys

- |  |   |
|--|---|
| 1. <input type="text" value="3"/>          | 14. <input type="text" value="2"/>                    |
| 2. <input type="text" value="2"/>          | 15. <input type="text" value="3"/>                    |
| 3. <input type="text" value="-2"/>         | 16. <input type="text" value="3"/>                    |
| 4. <input type="text" value="undefined"/>  | 17. <input type="text" value="-2"/>                   |
| 5. <input type="text" value="0"/>          | 18. <input type="text" value="1/2"/>                  |
| 6. <input type="text" value="3"/>          | 19. <input type="text" value="0"/>                    |
| 7. <input type="text" value="2"/>          | 20. <input type="text" value="-2"/>                   |
| 8. <input type="text" value="2"/>          | 21. <input type="text" value="3 miles per hour"/>     |
| 9. <input type="text" value="-3"/>         | 22. <input type="text" value="2"/>                    |
| 10. <input type="text" value="0"/>         | 23. <input type="text" value="60 mph"/>               |
| 11. <input type="text" value="undefined"/> | 24. <input type="text" value="0.4 cm/day"/>           |
| 12. <input type="text" value="2"/>         | 25. <input type="text" value="-60 gallons per hour"/> |
| 13. <input type="text" value="5/2"/>       | 26. <input type="text" value="1/3"/>                  |

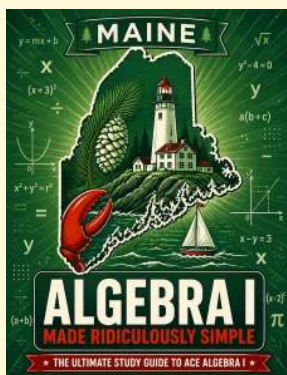
### Step-by-Step Tutor Notes

1. Use the clue in the question first, then let the arithmetic finish the job.  
 $m = \frac{8-2}{3-1} = \frac{6}{2} = 3$ . So the answer is 3.
2. Focus on the main idea of the problem, then simplify carefully.  $m = \frac{13-5}{4-0} = \frac{8}{4} = 2$ . So the answer is 2.
3. Line up the two changes first; that keeps the rate from getting mixed up.  
 $m = \frac{2-4}{2-(-1)} = \frac{-6}{3} = -2$ . Going down — negative slope. So the requested value is  $-2$ .
4. Compare the change in output to the change in input, because slope is a rate of change.  $x$  doesn't change, so the denominator is 0. Vertical line — slope is undefined. So the requested value is undefined.
5. Compare the change in output to the change in input, because slope is a rate of change.  $y$  doesn't change. Horizontal line — slope is 0. So the requested value is 0.
6. Line up the two changes first; that keeps the rate from getting mixed up.  
 $m = \frac{15-0}{5-0} = 3$ . Lines through the origin: slope is just  $y/x$ . So the requested value is 3.
7. Take it one clear step at a time and keep the original question in mind.  
 $m = \frac{7-1}{4-1} = \frac{6}{3} = 2$ . So the answer is 2.
8. Start with the definition the problem is testing, then apply it directly.  $m = \frac{6-(-2)}{1-(-3)} = \frac{8}{4} = 2$ . So the answer is 2.
9. This is a good place to slow down, check the notation, and simplify cleanly.  
 $m = \frac{8-(-1)}{2-5} = \frac{9}{-3} = -3$ . Watch the signs. So the answer is  $-3$ .
10. Compare the change in output to the change in input, because slope is a rate of change. Same  $y$  — horizontal line, slope 0. So the requested value is 0.
11. Line up the two changes first; that keeps the rate from getting mixed up. Same  $x$  — vertical line, slope undefined. So the requested value is undefined.
12. This is a good place to slow down, check the notation, and simplify cleanly.  
 $m = \frac{3-(-3)}{2-(-1)} = \frac{6}{3} = 2$ . So the answer is 2.
13. Compare the change in output to the change in input, because slope is a rate of change. Slope = rise/run =  $\frac{10}{4} = \frac{5}{2}$ . So the requested value is  $\frac{5}{2}$ .
14. Start with the definition the problem is testing, then apply it directly.  $\frac{6}{3} = 2$ . So the answer is 2.
15. Take it one clear step at a time and keep the original question in mind.  
 $m = \frac{11-2}{10-7} = \frac{9}{3} = 3$ . So the answer is 3.
16. Use the clue in the question first, then let the arithmetic finish the job.  
 $\frac{11-5}{3-1} = \frac{6}{2} = 3$ . So the answer is 3.
17. This is a good place to slow down, check the notation, and simplify cleanly.  
 $m = \frac{0-8}{4-0} = -2$ . Falling line. So the answer is  $-2$ .
18. Line up the two changes first; that keeps the rate from getting mixed up.  
 $m = \frac{5-1}{4-(-4)} = \frac{4}{8} = \frac{1}{2}$ . Gentle slope. So the requested value is  $\frac{1}{2}$ .
19. Think of slope as the amount the output changes for each 1-unit change in the input. Horizontal —  $y$  stays at  $-2$ , so slope is 0. So the requested value is 0.
20. Use the clue in the question first, then let the arithmetic finish the job.  
 $m = \frac{2-10}{5-1} = \frac{-8}{4} = -2$ . So the answer is  $-2$ .
21. Line up the two changes first; that keeps the rate from getting mixed up. The miles increase by 3 each hour, so the rate is 3 miles per hour. So the requested value is 3 miles per hour.
22. Think of slope as the amount the output changes for each 1-unit change in the input. The line rises 6 while running 3, so the rate is  $6/3 = 2$ . So the requested value is 2.
23. Rate = distance/time =  $\frac{180}{3} = 60$  mph. That's the slope of the (time, distance) line.
24.  $\frac{2}{5} = 0.4$  cm per day. That's the slope of the (days, height) line.
25. Change:  $760 - 1000 = -240$  gal over 4 hours. Rate =  $\frac{-240}{4} = -60$  gallons per hour. Negative because the volume is decreasing.
26. Line up the two changes first; that keeps the rate from getting mixed up. Slope =  $\frac{4}{12} = \frac{1}{3}$ . Roofers call this a 4:12 pitch. So the requested value is  $\frac{1}{3}$ .



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