Slope and Rate of Change

Name: _____	Date: _____	Score: _____ / 26

Quick Review

Slope measures how steep a line is — how much y changes for every 1 unit of x. The formula: $m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{\text{rise}}{\text{run}}$. 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. $(1, 2), (3, 8)$ _____
2. $(0, 5), (4, 13)$ _____
3. $(-1, 4), (2, -2)$ _____
4. $(3, 7), (3, -1)$ _____
5. $(-2, 5), (4, 5)$ _____
6. $(0, 0), (5, 15)$ _____
7. $(1, 1), (4, 7)$ _____
8. $(-3, -2), (1, 6)$ _____
9. $(5, -1), (2, 8)$ _____
10. $(0, -4), (6, -4)$ _____
11. $(2, 3), (2, 9)$ _____
12. $(-1, -3), (2, 3)$ _____
13. Rise 10, run 4 _____
14. Up 6, right 3 _____
15. $(7, 2), (10, 11)$ _____
16. Table: $x = 1 \to y = 5,\ x = 3 \to y = 11$ _____
17. $(0, 8), (4, 0)$ _____
18. $(-4, 1), (4, 5)$ _____
19. $(6, -2), (9, -2)$ _____
20. $(1, 10), (5, 2)$ _____

VISUAL PRACTICE

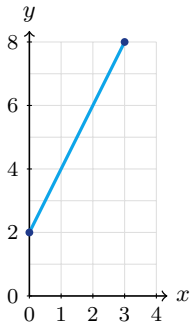
Use the graph, table, chart, or diagram to answer the question.

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: _____

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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. $\boxed{3}$
2. $\boxed{2}$
3. $\boxed{-2}$
4. $\boxed{\text{undefined}}$
5. $\boxed{0}$
6. $\boxed{3}$
7. $\boxed{2}$
8. $\boxed{2}$
9. $\boxed{-3}$
10. $\boxed{0}$
11. $\boxed{\text{undefined}}$
12. $\boxed{2}$
13. $\boxed{\frac{5}{2}}$
14. $\boxed{2}$
15. $\boxed{3}$
16. $\boxed{3}$
17. $\boxed{-2}$
18. $\boxed{\frac{1}{2}}$
19. $\boxed{0}$
20. $\boxed{-2}$
21. $\boxed{3 \text{ miles per hour}}$
22. $\boxed{2}$
23. $\boxed{60 \text{ mph}}$
24. $\boxed{0.4 \text{ cm/day}}$
25. $\boxed{-60 \text{ gallons per hour}}$
26. $\boxed{\frac{1}{3}}$

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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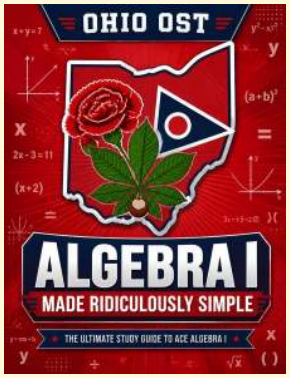

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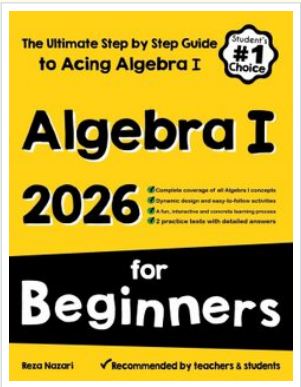

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