Slope as a Rate of Change

Name: _____	Date: _____	Score: _____ / 24

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

1. $m = 5$
2. $m = 3$
3. $m = 2$
4. $m = 2$
5. $m = 3$
6. $m = 0$
7. undefined
8. $m = -2$
9. $m = -2$
10. $m = 2$
11. $m = 2$
12. $m = \frac{2}{3}$
13. $m = \frac{1}{2}$
14. $m = -\frac{1}{2}$
15. $m = 0$
16. undefined
17. $m = 2$
18. $m = 3$
19. $m = -2$
20. $m = -\frac{3}{2}$
21. 2 cm per day
22. $m = -3$ cm per hour
23. \$2 per mile
24. \$30 per week

Step-by-Step Explanations

1. Rise $= 5 - 0 = 5$, run $= 1 - 0 = 1$, so $m = \frac{5}{1} = 5$.
2. Rise $= 8 - 2 = 6$, run $= 3 - 1 = 2$, so $m = \frac{6}{2} = 3$.
3. Rise $= 7 - 1 = 6$, run $= 5 - 2 = 3$, so $m = \frac{6}{3} = 2$.
4. Rise $= 12 - 4 = 8$, run $= 4 - 0 = 4$, so $m = 2$.
5. Rise $= 10 - 1 = 9$, run $= 4 - 1 = 3$, so $m = 3$.
6. The y-values are equal, so rise $= 0$. A flat line has slope 0.
7. The x-values are equal, so the run is 0. Dividing by 0 is undefined.
8. Rise $= 0 - 6 = -6$, run $= 3 - 0 = 3$, so $m = -2$ (line falls).
9. Rise $= 3 - 9 = -6$, run $= 4 - 1 = 3$, so $m = -2$.
10. Rise $= 10 - 2 = 8$, run $= 3 - (-1) = 4$, so $m = 2$.
11. Rise $= 5 - (-3) = 8$, run $= 2 - (-2) = 4$, so $m = 2$.
12. Rise $= 4$, run $= 6$, so $m = \frac{4}{6} = \frac{2}{3}$.
13. Rise $= 3 - 1 = 2$, run $= 5 - 1 = 4$, so $m = \frac{2}{4} = \frac{1}{2}$.
14. Rise $= 4 - 7 = -3$, run $= 8 - 2 = 6$, so $m = -\frac{1}{2}$.
15. Same y-value both times, so rise $= 0$ and $m = 0$.
16. Same x-value means run $= 0$; the slope is undefined (vertical).
17. Rise $= 9 - 1 = 8$, run $= 0 - (-4) = 4$, so $m = 2$.
18. Rise $= 4 - (-5) = 9$, run $= 4 - 1 = 3$, so $m = 3$.
19. Rise $= 0 - 10 = -10$, run $= 5 - 0 = 5$, so $m = -2$.
20. Rise $= -3 - 6 = -9$, run $= 4 - (-2) = 6$, so $m = -\frac{9}{6} = -\frac{3}{2}$.
21. Rise $= 16 - 4 = 12$ cm, run $= 8 - 2 = 6$ days, so the rate is $\frac{12}{6} = 2$ cm per day.
22. Rise $= 8 - 20 = -12$, run $= 5 - 1 = 4$, so $m = -3$. The candle shortens by 3 cm each hour.
23. Rise $= 20 - 8 = 12$ dollars, run $= 8 - 2 = 6$ miles, so the rate is $\frac{12}{6} = \$2$ per mile.
24. Rise $= 390 - 150 = 240$ dollars, run $= 8 - 0 = 8$ weeks, so $\frac{240}{8} = \$30$ per week.

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