

# Introduction to Slope and Linear Relationships

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

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

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The **slope** of a line tells you its steepness and direction—how much the line rises or falls for every unit you move to the right. You calculate it as  $m = \frac{\text{rise}}{\text{run}}$ , the change in  $y$  divided by the change in  $x$  between any two points. A positive slope means the line climbs, a negative slope means it drops, zero gives a flat horizontal line, and an undefined slope gives a vertical one. A **linear relationship** graphs as a straight line whose equation can be written  $y = mx + b$ , where  $m$  is the slope and  $b$  is the  $y$ -intercept—the point where the line crosses the  $y$ -axis. Understand slope now and you will have the foundation for graphing, writing equations, and studying functions in algebra and beyond!



## Key Concepts & Quick Review

### Slope Formula:

$$m = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$$

- **Positive slope** — line goes *up* from left to right.
- **Negative slope** — line goes *down* from left to right.
- **Zero slope** — horizontal line ( $y$  does not change).
- **Undefined slope** — vertical line ( $x$  does not change).

**Slope-intercept form:**  $y = mx + b$ , where  $m$  is the slope and  $b$  is the  $y$ -intercept (where the line crosses the  $y$ -axis).



### Examples

① Find the slope of the line passing through (1, 2) and (4, 8).

**Think It Through:**  $m = \frac{8-2}{4-1} = \frac{6}{3} = 2$ . The line rises 2 units for every 1 unit to the right.

**Answer:**  $m = 2$

② A line has the equation  $y = -3x + 5$ . What are the slope and  $y$ -intercept?

**Think It Through:** The equation is already in slope-intercept form  $y = mx + b$ . So  $m = -3$  (the line goes down) and  $b = 5$  (crosses the  $y$ -axis at (0, 5)).

**Answer:** slope =  $-3$ ,  $y$ -intercept = 5

### Practice Problems

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

- Find the slope of the line through (2, 3) \_\_\_\_\_ and (5, 9).
- Find the slope of the line through (0, 4) \_\_\_\_\_ and (3, 1).
- Find the slope of the line through (1, -2) \_\_\_\_\_ and (4, 7).
- Find the slope of the line through (-3, 5) \_\_\_\_\_ and (1, 5).
- Find the slope of the line through (6, 2) \_\_\_\_\_ and (6, 8).
- Find the slope of the line through (0, 0) \_\_\_\_\_ and (4, 10).
- Find the slope of the line through (-1, 3) \_\_\_\_\_ and (2, -3).
- Find the slope of the line through (3, 7) \_\_\_\_\_ and (5, 11).
- Find the slope of the line through (4, -1) \_\_\_\_\_ and (8, 3).
- Find the slope of the line through (-2, -4) and (1, 5).
- Find the slope  $m$  of the line  $y = 4x - 7$ . \_\_\_\_\_
- Find the slope  $m$  of the line  $y = -\frac{1}{2}x + 3$ . \_\_\_\_\_
- Find the slope  $m$  of the line  $y = x + 6$ . \_\_\_\_\_
- Find the slope  $m$  of the line  $y = -5x$ . \_\_\_\_\_
- Find the  $y$ -intercept  $b$  of the line  $y = \frac{2}{3}x - 1$ . \_\_\_\_\_

### Study Tips

- Remember: **rise over run**. Rise is the vertical change ( $y$ ) and run is the horizontal change ( $x$ ).
- A **steeper** line has a slope with a larger absolute value. A slope of 5 is steeper than a slope of 2.
- If two points have the **same  $x$ -value**, the slope is undefined (you would divide by zero).



 Word Problems

16. A plant is 3 cm tall on Day 1 and 15 cm tall on Day 7. If the growth is linear, what is the rate of growth (slope) in cm per day? \_\_\_\_\_

17. A phone plan charges a \$10 monthly fee plus \$0.05 per text message. Write an equation for the total monthly cost  $y$  in terms of the number of texts  $x$ . Then find the cost for 200 texts. \_\_\_\_\_

18. Use the line graphed here to find the slope of the line, identify the  $y$ -intercept, and write the equation in the form  $y = mx + b$ .



\_\_\_\_\_



## Answer Keys

- |                  |  |
|------------------|--|
| 1) 2             | 10) 3  |
| 2) -1            | 11) 4  |
| 3) 3             | 12) $-\frac{1}{2}$                                       |
| 4) 0             | 13) 1  |
| 5) undefined     | 14) -5   |
| 6) $\frac{5}{2}$ | 15) -1   |
| 7) -2            | 16) 2 cm per day   |
| 8) 2             | 17) $y = 0.05x + 10$ ; for 200 texts the cost is \$20.   |
| 9) 1             | 18) $m = \frac{1}{2}$ ; $b = 1$ ; $y = \frac{1}{2}x + 1$ |

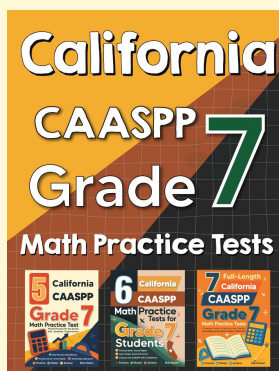
### Step-by-Step Explanations

*Tutoring notes not found for this topic.*



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