LINEAR FUNCTION: SLI

$y = mx + b$ (m: SLOPE (IMPROPER FRACTION), Simplified; b: Y-INTERCEPT)

4.4 Find Slope and Rate of Change

Goal • Find the slope of a line and interpret slope as a rate of change.

Your Notes

VOCABULARY The variable that represents slope is "m"

Slope describes the steepness of a line.

There are 2 definitions for slope depending on whether you have a graph or 2 points.

Rate of change Compares a change in one QUANTITY TO A change in another QUANTITY

See Example 3

RATE OF CHANGE = $\frac{\text{Change in 1 QUANTITY}}{\text{Change in another QUANTITY}}$

FINDING THE SLOPE OF A LINE

METHOD II (2): GIVEN 2 POINTS:

The slope of the nonvertical line passing through the two points (x_1, y_1) and (x_2, y_2).

POINT 1 POINT 2

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\text{change in } y}{\text{change in } x} = \frac{\Delta y}{\Delta x}$$

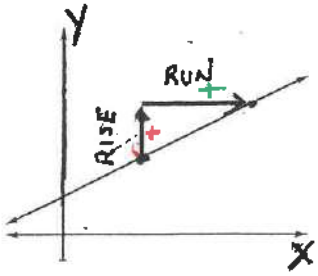
same

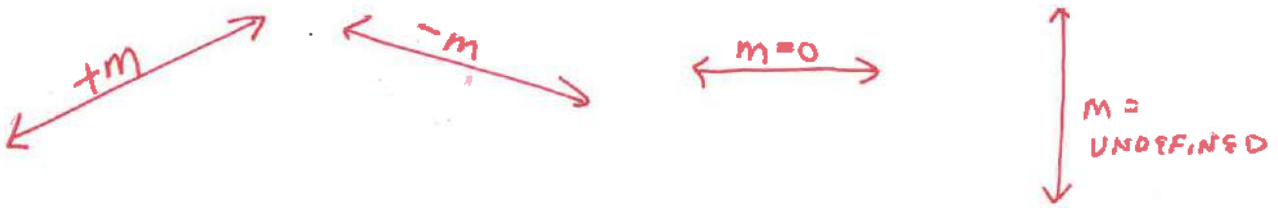
$$m = \frac{\Delta y}{\Delta x} = \frac{y_1 - y_2}{x_1 - x_2}$$

METHOD I (1): GIVEN A GRAPH:

Graph

$$\text{slope} = \frac{\text{RISE}}{\text{RUN}}$$





Your Notes

METHOD I

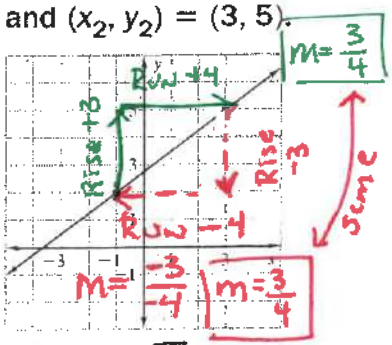
Given a Graph

$M = \frac{\text{RISE}}{\text{RUN}}$

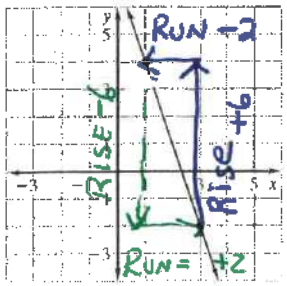
Example 1 *Find a slope*

Find the slope of the line shown. USING RISE OVER RUN.

a. Let $(x_1, y_1) = (-1, 2)$ and $(x_2, y_2) = (3, 5)$.



b. Let $(x_1, y_1) = (1, 4)$ and $(x_2, y_2) = (3, -2)$.



$M = \frac{+6}{-2}$

$M = -3$

OR

$M = -3/1$

METHOD II: USE $m = \Delta Y / \Delta X$

$M = -\frac{3}{1} = \frac{-3}{1} = \frac{3}{-1}$

ALL EQUAL

Keep the x- and y-coordinates in the same order in the numerator and denominator when calculating slope. This will help avoid error.

a. $m = \frac{y_2 - y_1}{x_2 - x_1}$ **Write formula for slope.**

PTS $(-1, 2)$ $(3, 5)$
x y x y

$M = \frac{2-5}{-1-3} = \frac{-3}{-4}$ **Substitute.**

$M = 3/4$ **Simplify.**

* The line RISES from left to right. The slope is POSITIVE.

+M

b. $m = \frac{\Delta Y}{\Delta X}$ **Write formula for slope.**

(1, 4) (3, -2)

$M = \frac{4 - (-2)}{1 - 3}$ **Substitute.**

$M = \frac{6}{-2} = M = -3$ **Simplify.**

* The line FALLS from left to right. The slope is NEGATIVE.

ALWAYS WRITE

m =

Checkpoint **Find the slope of the line passing through the points.**

1. $(-3, -1)$ and $(-2, 1)$	2. $(-6, 3)$ and $(5, -2)$
$M = \frac{-1-1}{-3+2} = \frac{-2}{-1}$ or $\frac{1-(-1)}{-2-(-3)}$	$M = \frac{3+2}{-6-5} =$ or $\frac{-2-3}{5-(-6)}$
$m = 2$	$M = \frac{5}{-11}$

Remember:

$-\frac{5}{11} = \frac{-5}{11} = \frac{5}{-11}$

These fractions are the same

Your Notes

Example 2 *Find the slope of a line*

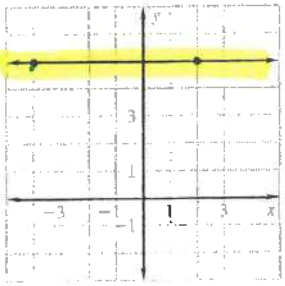
Find the slope of the line shown.

METHOD I

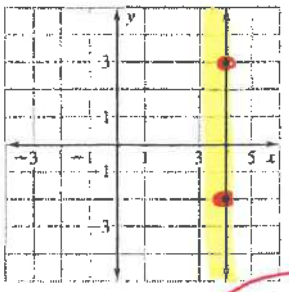
$m = \frac{\text{Rise}}{\text{Run}} = \frac{0}{6}$

$m = 0$

a. Let $(x_1, y_1) = (2, 5)$ and $(x_2, y_2) = (-4, 5)$.



b. Let $(x_1, y_1) = (4, -2)$ and $(x_2, y_2) = (4, 3)$.



$m = \frac{\text{Rise}}{\text{Run}}$

$m = \frac{5}{0}$

m = UNDEFINED

METHOD II : USE $m = \Delta y / \Delta x$.

a. $m = \frac{\Delta y}{\Delta x}$ **Write formula for slope.**

(2, 5) (−4, 5)

$x \quad y \quad x \quad y$

$m = \frac{5-5}{2-(-4)} = \frac{0}{6}$ **Substitute.**

$m = 0$ **Simplify.**

* The line is HORIZONTAL. The slope is ZERO (0)

b. $m = \frac{\Delta y}{\Delta x}$ **Write formula for slope.**

(4, −2) (4, 3)

$x \quad y \quad x \quad y$

$m = \frac{-2-3}{4-4} = \frac{-5}{0}$ **Substitute.**

m = UNDEFINED **Simplify.**

* The line is VERTICAL. The slope is UNDEFINED

Checkpoint **Find the slope of the line passing through the points. Then classify the line by its slope.**

3. (1, −2) and (1, 3)	**4.** (−3, 7) and (4, 7)
$m = \frac{-2-3}{1-1} = \frac{-5}{0}$	$m = \frac{7-7}{-3-4} = \frac{0}{-7}$
m = UNDEFINED	$m = 0$

Your Notes

Example 3 *Find a rate of change*

Gas Prices The table shows the cost of a gallon of gas for a number of days. Find the rate of change with respect to time.

TIME IS IN THE DENOMINATOR

Time (days)	Day 1	Day 3	Day 5
Price/gal ($)	1.99	2.09	2.19

Rate of change $= \frac{\text{change in cost}}{\text{change in time}}$ **Write formula.**

$\frac{\$'s}{time} = \frac{2.09 - 1.99}{3 - 1}$ **Substitute.**

$= \frac{\$.10}{2 \text{ DAYS}}$ **Simplify.**

$= \$.05/\text{DAY}$

The rate of change in price is 5¢ per day.

Checkpoint

5. The table shows the change in temperature over time. Find the rate of change in degrees Fahrenheit with respect to time.

Temperature (°F)	Time (hours)
38	0
43	2
48	4
53	6

UNITS

$\text{Rate} = \frac{\Delta \text{TEMP}}{\Delta \text{Time}} = \frac{°F}{hrs}$

$\text{Rate} = \frac{43 - 38}{2 - 0} = \frac{5}{2}$

The rate is 2.5°F per hour

Homework

Name _____ Date _____

LESSON 4.4

Practice C

For use with pages 234–242

GIVEN GRAPH → $M = \frac{\text{RISE}}{\text{RUN}}$

Find the slope of the line that passes through the points.

7. (−9, 4), (−6, −2)

$M = \frac{3}{-1.5}$

$M = \frac{+6}{-3}$ → $M = -2$

8. $M = \frac{+22}{-12}$ $M = -\frac{11}{6}$

9. $M = \frac{+8}{-12}$ $M = -2/3$

10. (1, 3), (4, 7)

$M = \frac{+4}{+3}$ $m = 4/3$

11. (−4, 2), (5, −1)

$M = \frac{+3}{-9}$ $M = -1/3$

12. (−5, 5), (2, 5)

HORIZONTAL LINE ALWAYS HAVE SLOPE = $m = 0$

$M = \frac{0}{7}$ $\frac{(\text{RISE})}{(\text{RUN})}$ $M = \text{ZERO}$

13. (−2, 1), (1, −4)

$M = \frac{+5}{-3}$ $m = -5/3$

14. (−1, 5), (2, 3)

$M = \frac{+2}{-3}$ $M = -2/3$

15. (3, 4), (3, −2)

VERTICAL LINES ALWAYS HAVE SLOPE = M = UNDEFINED

$M = \frac{6}{0}$, $\frac{\text{RISE}}{\text{RUN}}$ M = UNDEFINED

LESSON 4.4

Practice C *continued*

For use with pages 234–242

GIVEN 2 POINTS → $m = \frac{y_2 - y_1}{x_2 - x_1}$ OR $m = \frac{\Delta y}{\Delta x}$

Find the slope of the line that passes through the points.

16. (3, 4) and (8, 7)

$M = \frac{4-7}{3-8}$

$M = \frac{-3}{-5}$ $m = 3/5$

17. (5, 5) and (−2, 1)

$M = \frac{5-1}{5-(-2)}$

$M = 4/7$

18. (6, −1) and $\left(6, \frac{1}{2}\right)$

$M = \frac{-1-1/2}{6-6}$

$M = \frac{-1.5}{0}$

$m =$ UNDEFINED

19. (4, 2) and (−6, 6)

$M = \frac{2-6}{4-(-6)}$

$M = \frac{-4}{10}$ $M = -2/5$

20. (−3, 4) and (4, 8)

$M = \frac{4-8}{-3-4}$

$M = \frac{-4}{-7}$ $M = 4/7$

21. (1, −9) and (6, −5)

$M = \frac{-9-(-5)}{1-6}$

$M = \frac{-4}{-5}$ $m = 4/5$

22. (2, −5) and (5, −5)

$M = \frac{-5-(-5)}{2-5}$

$M = \frac{0}{-3}$

$m = 0$

23. (−8, −7) and (−4, −2)

$M = \frac{-7-(-2)}{-8-(-4)}$

$M = -5/-4$

$M = 5/4$

24. (−2, −6) and (4, −5)

$M = \frac{-6-(-5)}{-2-4}$

$M = \frac{-1}{-6}$

$M = 1/6$