

LINEAR FUNCTION: S/I

$$y = mx + b$$

SLOPE (IMPROPER FRACTION) Y-INTERCEPT

↑ Simplified

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

RATE OF CHANGE =

$$\frac{\text{Change in 1 quantity}}{\text{Change in another quantity}}$$

See Example 3

FINDING THE SLOPE OF A LINE

METHOD I: GIVEN 2 POINTS:

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

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

↑ POINT 1 ↑ POINT 2

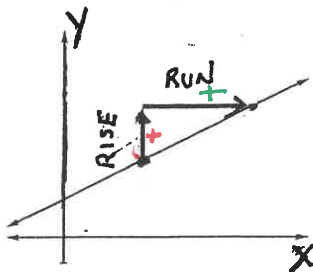
↑ Same

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

METHOD II: GIVEN A GRAPH:

Graph

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



↙ +m ↘

↖ -m ↗

↔ m=0

↑ m = UNDEFINED

Your Notes

METHOD I

Given a Graph

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

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

ALWAYS WRITE

$$m = \boxed{\quad}$$

Remember:

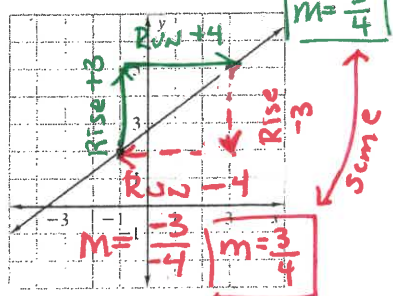
$$-\frac{5}{11} = \frac{-5}{11} = \frac{5}{-11}$$

These fractions are the same

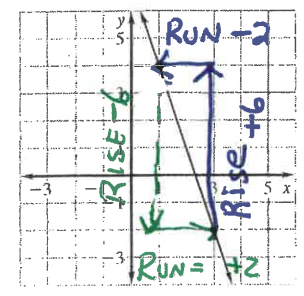
Example 1 Find a slope

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 $m = \Delta y / \Delta x$

a. $m = \frac{y_2 - y_1}{x_2 - x_1}$

$$m = \frac{5 - 2}{3 - (-1)} = \frac{3}{4}$$

Write formula for slope.
PTS $(-1, 2)$ $(3, 5)$
Substitute.
Simplify.

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

ALL EQUAL

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

b. $m = \frac{\Delta y}{\Delta x}$

$$m = \frac{4 - (-2)}{1 - 3} = \frac{6}{-2} = -3$$

Write formula for slope.
 $(1, 4)$ $(3, -2)$
Substitute.
Simplify.

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

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

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

Your Notes

Example 2 Find the slope of a line

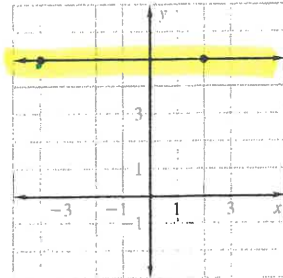
Find the slope of the line shown.

METHOD I

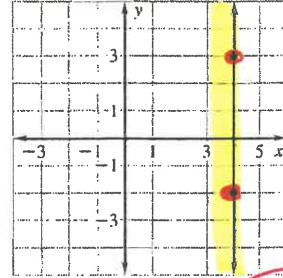
$$m = \frac{\text{Rise}}{\text{Run}} = \frac{0}{8}$$

$$m = 0$$

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



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



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

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

$$m = \text{UNDEFINED}$$

METHOD II : USE $m = \frac{\Delta y}{\Delta x}$.

a. $m = \frac{\Delta y}{\Delta x}$

Write formula for slope.

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

$(2, 5)$ $(-4, 5)$
x y x y
Substitute.

$$m = 0$$

Simplify.

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

b. $m = \frac{\Delta y}{\Delta x}$

Write formula for slope.

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

$(4, -2)$ $(4, 3)$
x y x y
Substitute.

$$m = \text{UNDEFINED}$$

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 $(4, 7)$
$m = \frac{-2-3}{1-1} = \frac{-5}{0}$	$m = \frac{7-7}{-3-4} = \frac{0}{-7}$
$m = \text{UNDEFINED}$	$m = 0$

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.

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

UNITS

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

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

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

The rate is 2.5°F per hour

Homework

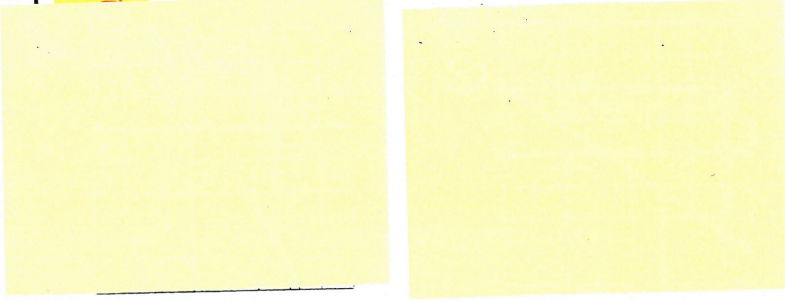
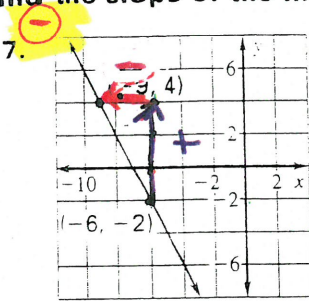
LESSON 4.4

Practice C
For use with pages 234-242

GIVEN GRAPH →

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

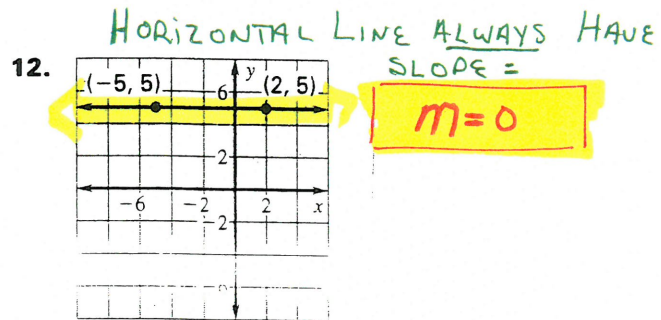
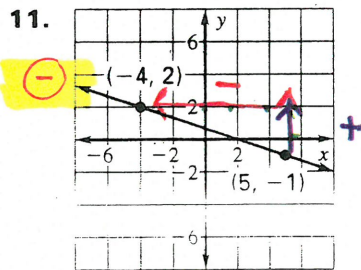
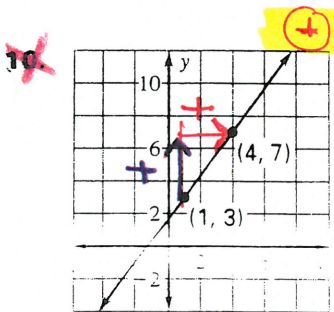
Find the slope of the line that passes through the points.



$M = \frac{3}{-1.5}$
 $M = \frac{+6}{-3}$ → $M = -2$

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

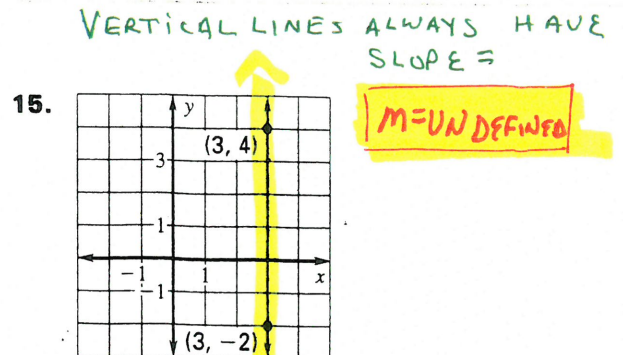
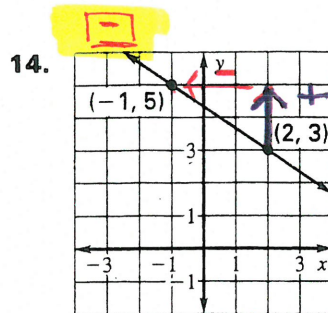
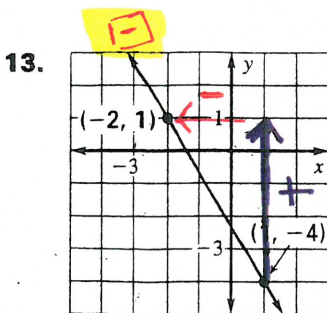
$M = \frac{+8}{-12}$ → $M = -\frac{2}{3}$



$M = \frac{+4}{+3}$ → $M = \frac{4}{3}$

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

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



$M = \frac{+5}{-3}$ → $M = -\frac{5}{3}$

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

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

GIVEN 2 POINTS →

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

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

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

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

$$m = \frac{-3}{-5} \quad \boxed{m = 3/5}$$

17. (5, 5) and (-2, 1)

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

$$\boxed{m = 4/7}$$

18. (6, -1) and (6, 1/2)

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

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

$m =$
UNDEFINED

19. (4, 2) and (-6, 6)

$$\frac{6-2}{-6-4} = \frac{4}{-10}$$

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

$$m = \frac{-4}{10} \quad \boxed{m = -2/5}$$

20. (-3, 4) and (4, 8)

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

$$m = \frac{-4}{-7}$$

$$\boxed{m = 4/7}$$

21. (1, -9) and (6, -5)

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

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

$$\boxed{m = 4/5}$$

22. (2, -5) and (5, -5)

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

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

$$\boxed{m = 0}$$

23. (-8, -7) and (-4, -2)

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

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

$$\boxed{m = 5/4}$$

24. (-2, -6) and (4, -5)

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

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

$$\boxed{m = 1/6}$$