

# 2.2

## Find Slope and Rate of Change

**Goal** • Find slopes of lines and rates of change.

### Your Notes

#### VOCABULARY

Slope

Parallel

Perpendicular

Rate of change

#### SLOPE OF A LINE

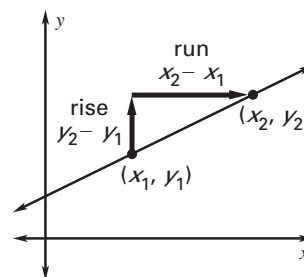
##### Words

The slope  $m$  of a nonvertical line is the ratio of \_\_\_\_\_ change (the rise) to \_\_\_\_\_ change (the run).

##### Algebra

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\boxed{\phantom{000}}}{\boxed{\phantom{000}}}$$

##### Graph



#### Example 1 Find slope

What is the slope of the line passing through the points (1, 3) and (6, 7)?

Let  $(x_1, y_1) = (1, 3)$  and  $(x_2, y_2) = (6, 7)$ .

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\boxed{\phantom{000}}}{\boxed{\phantom{000}}} = \frac{\boxed{\phantom{000}}}{\boxed{\phantom{000}}}$$

The slope of the line is \_\_\_\_\_.

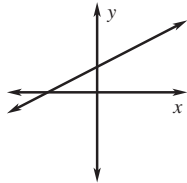
When calculating the slope, be sure to subtract the  $x$ - and  $y$ -coordinates in the correct order.

## Your Notes

A vertical line has "undefined slope" because for any two points, the slope formula's denominator becomes 0, and division by 0 is undefined.

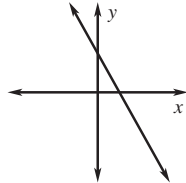
### CLASSIFICATION OF LINES BY SLOPE

The slope of a line indicates whether the line \_\_\_\_\_ from left to right, \_\_\_\_\_ from left to right, is \_\_\_\_\_, or is \_\_\_\_\_.



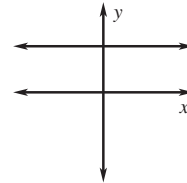
**Positive slope**

Rises from left to right



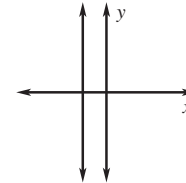
**Negative slope**

Falls from left to right



**Zero slope**

Horizontal



**Undefined slope**

Vertical

### Example 2 Classify lines using slope

Without graphing, tell whether the line through the given points *rises, falls, is horizontal, or is vertical*.

a.  $(-6, -2), (1, 3)$

b.  $(2, -1), (2, 2)$

**Solution**

a.  $m = \frac{\boxed{\phantom{000}}}{\boxed{\phantom{000}}} = \underline{\phantom{00}}$

Because  $m$       0, the line \_\_\_\_\_.

b.  $m = \frac{\boxed{\phantom{000}}}{\boxed{\phantom{000}}} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}}$

Because  $m$  is \_\_\_\_\_, the line is \_\_\_\_\_.

✔ **Checkpoint** Complete the following exercises.

1. Find the slope of the line passing through the points  $(4, 2)$  and  $(7, 9)$ .

2. Without graphing tell whether the line through the points  $(-3, 2)$  and  $(1, 4)$  *rises, falls, is horizontal, or is vertical*.

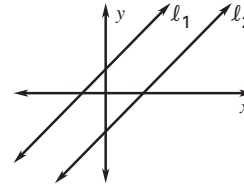
## Your Notes

### SLOPES OF PARALLEL AND PERPENDICULAR LINES

Consider two different nonvertical lines  $l_1$  and  $l_2$  with slopes  $m_1$  and  $m_2$ .

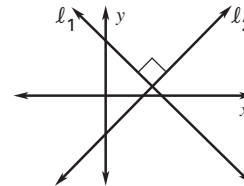
**Parallel lines** The lines are parallel if and only if they have the \_\_\_\_\_ slope.

$$m_1 \text{ \_\_\_\_ } m_2$$



**Perpendicular lines** The lines are perpendicular if and only if their slopes are \_\_\_\_\_ of each other.

$$m_1 = \text{ \_\_\_\_\_\_ }, \text{ or } m_1 m_2 = \text{ \_\_\_\_\_\_ }$$



#### Example 3 Classify parallel and perpendicular lines

Tell whether the lines are *parallel* or *perpendicular*.

**Line 1:** through  $(-3, -1)$  and  $(2, 5)$

**Line 2:** through  $(3, -4)$  and  $(-3, 1)$

Find the slopes of the two lines.

$$m_1 = \frac{\boxed{\phantom{000}}}{\boxed{\phantom{000}}} = \text{ \_\_\_\_\_\_ } \quad m_2 = \frac{\boxed{\phantom{000}}}{\boxed{\phantom{000}}} = \text{ \_\_\_\_\_\_ }$$

Because  $m_1 m_2 = \text{ \_\_\_\_\_\_ } (\text{ \_\_\_\_\_\_ }) = \text{ \_\_\_\_\_\_ }$ ,  $m_1$  and  $m_2$  are negative \_\_\_\_\_ of each other. So, the lines are \_\_\_\_\_.

### Homework

✓ **Checkpoint** Tell whether the lines are *parallel*, *perpendicular*, or *neither*.

**3. Line 1:** through  $(1, 0)$  and  $(3, 4)$

**Line 2:** through  $(24, 6)$  and  $(22, 5)$