

# 4.1 Climbing Stairs

## Using Rise and Run

Climbing stairs is good exercise, so some athletes run up and down stairs as part of their training. The steepness of stairs determines how difficult they are to climb. By investigating the steepness of stairs, you can find another important way to describe the steepness of a line.

Consider these questions about the stairs you use at home, in your school, and in other buildings.

- How can you describe the steepness of the stairs?
- Is the steepness the same between any two consecutive steps?

Carpenters have developed the guidelines below to ensure that the stairs they build are relatively easy for a person to climb. Steps are measured in inches.

- The ratio of rise to run for each step should be between 0.45 and 0.60.
- The rise plus the run for each step should be between 17 and  $17\frac{1}{2}$  inches.

The steepness of stairs is determined by the ratio of the rise to the run for each step. The rise and run are labeled in the diagram below.



### Problem 4.1

- A** 1. Determine the steepness of a set of stairs in your school or home. To calculate the steepness you will need to
- measure the rise and run of at least two steps in the set of stairs.
  - make a sketch of the stairs, and label the sketch with the measurements you found.
  - find the ratio of rise to run.
2. How do the stairs you measured compare to the carpenters' guidelines on the previous page?
- B** A set of stairs is being built for the front of the new Arch Middle School. The ratio of rise to run is 3 to 5.
1. Is this ratio within the carpenters' guidelines?
  2. Make a sketch of a set of stairs that meet this ratio. Label the lengths of the rise and run of a step.
  3. Sketch the graph of a line that passes through the origin and whose  $y$ -values change by 3 units for each 5-unit change in the  $x$ -values.
  4.
    - a. Write an equation for the line in part (3).
    - b. What is the coefficient of  $x$  in the equation?
    - c. How is the coefficient related to the steepness of the line represented by the equation?
    - d. How is the coefficient related to the steepness of a set of stairs with this ratio?

### ACE

Homework starts on page 98.