

# Chapter 1

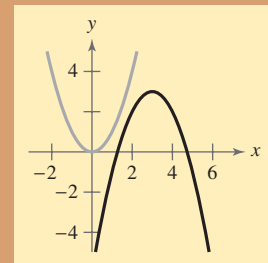
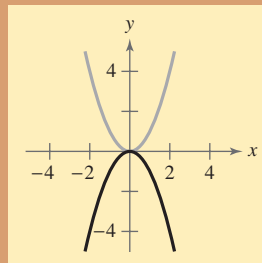
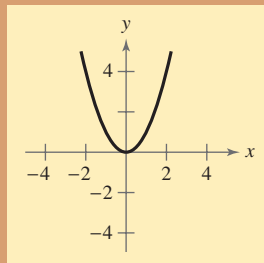
## Functions and Their Graphs

- 1.1 Graphs of Equations
- 1.2 Lines in the Plane
- 1.3 Functions
- 1.4 Graphs of Functions
- 1.5 Shifting, Reflecting, and Stretching Graphs
- 1.6 Combinations of Functions
- 1.7 Inverse Functions

### Selected Applications

Functions have many real-life applications. The applications listed below represent a small sample of the applications in this chapter.

- Data Analysis, Exercise 73, page 86
- Rental Demand, Exercise 86, page 99
- Postal Regulations, Exercise 81, page 112
- Motor Vehicles, Exercise 87, page 113
- Fluid Flow, Exercise 92, page 125
- Finance, Exercise 58, page 135
- Bacteria, Exercise 81, page 146
- Consumer Awareness, Exercises 84, page 146
- Shoe Sizes, Exercises 103 and 104, page 156



An equation in  $x$  and  $y$  defines a relationship between the two variables. The equation may be represented as a graph, providing another perspective on the relationship between  $x$  and  $y$ . In Chapter 1, you will learn how to write and graph linear equations, how to evaluate and find the domains and ranges of functions, and how to graph functions and their transformations.

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Refrigeration slows down the activity of bacteria in food so that it takes longer for the bacteria to spoil the food. The number of bacteria in a refrigerated food is a function of the amount of time the food has been out of refrigeration.

## Introduction to Library of Parent Functions

In Chapter 1, you will be introduced to the concept of a *function*. As you proceed through the text, you will see that functions play a primary role in modeling real-life situations.

There are three basic types of functions that have proven to be the most important in modeling real-life situations. These functions are algebraic functions, exponential and logarithmic functions, and trigonometric and inverse trigonometric functions. These three types of functions are referred to as the *elementary functions*, though they are often placed in the two categories of *algebraic functions* and *transcendental functions*. Each time a new type of function is studied in detail in this text, it will be highlighted in a box similar to this one. The graphs of many of these functions are shown on the inside front cover of this text. A review of these functions can be found in the *Study Capsules*.

### Algebraic Functions

These functions are formed by applying algebraic operations to the identity function  $f(x) = x$ .

| Name       | Function                                                                | Location    |
|------------|-------------------------------------------------------------------------|-------------|
| Linear     | $f(x) = ax + b$                                                         | Section 1.2 |
| Quadratic  | $f(x) = ax^2 + bx + c$                                                  | Section 3.1 |
| Cubic      | $f(x) = ax^3 + bx^2 + cx + d$                                           | Section 3.2 |
| Polynomial | $P(x) = a_n x^n + a_{n-1} x^{n-1} + \cdots + a_2 x^2 + a_1 x + a_0$     | Section 3.2 |
| Rational   | $f(x) = \frac{N(x)}{D(x)}$ , $N(x)$ and $D(x)$ are polynomial functions | Section 3.5 |
| Radical    | $f(x) = \sqrt[n]{P(x)}$                                                 | Section 1.3 |

### Transcendental Functions

These functions cannot be formed from the identity function by using algebraic operations.

| Name                  | Function                                                                                                     | Location                  |
|-----------------------|--------------------------------------------------------------------------------------------------------------|---------------------------|
| Exponential           | $f(x) = a^x$ , $a > 0$ , $a \neq 1$                                                                          | Section 4.1               |
| Logarithmic           | $f(x) = \log_a x$ , $x > 0$ , $a > 0$ , $a \neq 1$                                                           | Section 4.2               |
| Trigonometric         | $f(x) = \sin x$ , $f(x) = \cos x$ , $f(x) = \tan x$ ,<br>$f(x) = \csc x$ , $f(x) = \sec x$ , $f(x) = \cot x$ | Not covered in this text. |
| Inverse Trigonometric | $f(x) = \arcsin x$ , $f(x) = \arccos x$ , $f(x) = \arctan x$                                                 | Not covered in this text. |

### Nonelementary Functions

Some useful nonelementary functions include the following.

| Name              | Function                                                                  | Location    |
|-------------------|---------------------------------------------------------------------------|-------------|
| Absolute value    | $f(x) =  g(x) $ , $g(x)$ is an elementary function                        | Section 1.3 |
| Piecewise-defined | $f(x) = \begin{cases} 3x + 2, & x \geq 1 \\ -2x + 4, & x < 1 \end{cases}$ | Section 1.3 |
| Greatest integer  | $f(x) = \llbracket g(x) \rrbracket$ , $g(x)$ is an elementary function    | Section 1.4 |
| Data defined      | Formula for temperature: $F = \frac{9}{5}C + 32$                          | Section 1.3 |