CHAPTER 7

Exponents and Exponential Functions

In this chapter, you will:

- Simplify and perform operations on expressions involving exponents.
- Extend the properties of integer exponents to rational exponents.
- Use scientific notation.
- Graph and use exponential functions.

KeyConcepts

Multiplication and Division Properties of Exponents (Lessons 7-1 and 7-2)

For any nonzero real numbers a and b and any integers m, n, and p, the following are true.

- Product of Powers: $a^m \cdot a^n = a^{m+n}$
- Power of a Power: $(a^m)^n = a^{m \cdot n}$
- Power of a Product: $(ab)^m = a^m b^m$
- Quotient of Powers: $\frac{a^m}{a^p} = a^{m-p}$
- Power of a Quotient: $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$
- Zero Exponent: $a^0 = 1$
- Negative Exponent: $a^{-n} = \frac{1}{a^n}$ and $\frac{1}{a^{-n}} = a^n$

Rational Exponents (Lesson 7-3)

For any positive real number b and any integers m and $n > 1$, the following are true.

$b^{\frac{1}{2}} = \sqrt{b}$ $\qquad$ $b^{\frac{1}{n}} = \sqrt[n]{b}$ $\qquad$ $b^{\frac{m}{n}} = \left(\sqrt[n]{b}\right)^m$ or $\sqrt[n]{b^m}$

Scientific Notation (Lesson 7-4)

- A number is in scientific notation if it is in the form $a \times 10^n$, where $1 \leq a < 10$.
- To write in standard form:
  - If $n > 0$, move the decimal n places right.
  - If $n < 0$, move the decimal n places left.

Exponential Functions (Lessons 7-5 and 7-6)

- The equation for exponential growth is $y = a(1 + r)^t$, where $r > 0$. The equation for exponential decay is $y = a(1 - r)^t$, where $0 < r < 1$. y is the final amount, a is the initial amount, r is the rate of change, and t is the time in years.

KeyVocabulary

- common ratio (p. 438)
- compound interest (p. 433)
- constant (p. 391)
- cube root (p. 407)
- exponential decay (p. 424)
- exponential equation (p. 409)
- exponential function (p. 424)
- exponential growth (p. 424)
- geometric sequence (p. 438)
- monomial (p. 391)
- negative exponent (p. 400)
- nth root (p. 407)
- order of magnitude (p. 401)
- rational exponent (p. 406)
- recursive formula (p. 445)
- scientific notation (p. 414)
- zero exponent (p. 399)