6 Algebraic Models

Strand
Mathematical Models

Student Text Pages
338–397

Suggested Timing
5 min

Related Resources
BLM A-4 Presentation Checklist

Key Terms
cube root
*n*th root
radical
rational exponent

Curriculum Expectations

Solving Exponential Equations

In this chapter, students will

MM1.01 determine, through investigation (e.g., by expanding terms and patterning), the exponent laws for multiplying and dividing algebraic expressions involving exponents [e.g., $(x^3)(x^2)$, $x^3 \div x^5$] and the exponent law for simplifying algebraic expressions involving a power of a power [e.g., $(x^6y^3)^2$]

MM1.02 simplify algebraic expressions containing integer exponents using the laws of exponents

MM1.03 determine through investigation using a variety of tools (e.g., calculator, paper and pencil, graphing technology) and strategies (e.g., patterning; finding values from a graph; interpreting the exponent laws) the value of a power with a rational exponent (i.e., $x^{\frac{m}{n}}$, where $x > 0$ and m and n are integers)

MM1.04 evaluate, with or without technology, numerical expressions involving rational exponents and rational bases

[e.g., $\mathbf{2}^{-3}$, $(-6)^3$, $4^{\frac{1}{2}}$, 1.01^{120}]

MM1.05 solve simple exponential equations numerically and graphically, with technology (e.g., use systematic trial with a scientific calculator to determine the solution to the equation $1.05x = 1.276$), and recognize that the solution may not be exact

MM1.06 solve problems involving exponential equations arising from real-world applications by using a graph or a table of values generated with technology from a given equation (e.g., $h = 2(0.6)^n$, where h represents the height of a bouncing ball and n represents the number of bounces)

MM1.07 solve exponential equations in one variable by determining a common base (e.g., $2^x = 32$, $4^{5x-1} = 2^{2(x+11)}$, $3^{5x+8} = 27^x$)

Modelling Algebraically

MM3.01 solve equations of the form $x^n = a$ using rational exponents (e.g., solve $x^3 = 7$ by raising both sides to the exponent $\frac{1}{3}$)

MM3.02 determine the value of a variable of degree no higher than three, using a formula drawn from an application, by first subtracting known values and then solving for the variable, and by first isolating the variable and then substituting known values

MM3.03 make connections between formulas and linear, quadratic, and exponential functions (e.g., recognise that the compound interest formula, $A = P(1 + {}^{i})^n$, is an example of an exponential function $A(n)$, where P and i are constant, and of a linear function $A(P)$, when i and n are constant),using a variety of tools and strategies (e.g., comparing the graphs generated with technology when different variables in a formula are set as constants)

MM3.04 solve multi-step problems requiring formulas arising from real-world applications (e.g., determining the cost of two coats of paint for a large cylindrical tank)

MM3.05 gather, interpret, and describe information about applications of mathematical modelling in occupations, and about college programs that explore these applications

Teaching Suggestions

Chapter Opener

- Have students read the chapter opener. As a class, discuss the examples of algebraic modelling.
- Ask students if they recognize any of the key terms.

Career Profile

Have students discuss what they know about a career as a water treatment plant operator. As an extension, have students research this career and other careers that use algebraic modelling, and present their findings to the class. You may wish to use **BLM A-4 Presentation Checklist** to assess students' presentations.

Using their research, have students discuss:

- The duties of a water treatment plant operator.
- The type of education and training needed for this career.
- Other careers that use algebraic modelling.
- The differences in the training and education required for a similar career.

You may wish to have students include their research in their Portfolios.

Chapter 6 Planning Chart

Section Suggested Timing	Student Text Page(s)	Teacher's Resource Blackline Masters	Assessment	Tools
Chapter 6 Opener • 5 min	338–339		• BLM A-4 Presentation Checklist	
Prerequisite Skills • 40–80 min	340–341	• BLM 6-1 Prerequisite Skills	• BLM 6-2 Prerequisite Skills Self-Assessment Checklist	• graphing calculators
6.1 Exponent Laws • 80–160 min	342–351	• BLM 6-3 Section 6.1 Investigate • BLM 6-4 Section 6.1 Exponent Laws • BLM T-5 The Computer Algebra System	• BLM 6-5 Section 6.1 Achievement Check Rubric	• scientific or graphing calculators
6.2 Rational Exponents • 80–160 min	352–361	• BLM 6-6 Section 6.2 Rational Exponents	• BLM 6-7 Section 6.2 Achievement Check Rubric	• graphing calculators *Optional* • computers with *The Geometer's Sketchpad*®
6.3 Represent Exponential Expressions • 80 min	362–367	• BLM 6-8 Section 6.3 Represent Exponential Expressions	• BLM 6-9 Section 6.3 Achievement Check Rubric • BLM A-9 Communication General Scoring Rubric	• graphing calculator *Optional* • computers with *The Geometer's Sketchpad*®
6.4 Tools and Strategies to Solve Equations Involving Exponents • 80 min	368–377	• BLM 6-10 Section 6.4 Investigate • BLM 6-11 Section 6.4 Tools and Strategies to Solve Equations Involving Exponents	• BLM 6-12 Section 6.4 Achievement Check Rubric	• graphing calculators *Optional* • TI-Nspire™ CAS graphing calculators
6.5 Construct and Apply Exponential Models • 80 min	378–389	• BLM 6-13 Section 6.5 Warm-Up • BLM 6-14 Section 6.5 Construct and Apply Exponential Models • BLM T-6 Using the CBR™	• BLM 6-15 Section 6.5 Achievement Check Rubric • BLM A-9 Communication General Scoring Rubric	• graphing calculators *Optional* • computers with *The Geometer's Sketchpad*®
Chapter 6 Review • 60–80 min	390–391	• BLM 6-16 Chapter 6 Literacy • BLM 6-17 Chapter 6 Review		• graphing calculators *Optional* • computers with *The Geometer's Sketchpad*®
Chapter 6 Practice Test • 60–80 min	392–393		• BLM 6-18 Chapter 6 Practice Test • BLM 6-19 Chapter 6 Test	• graphing calculators *Optional* • computers with *The Geometer's Sketchpad*®
Chapter 6 Problem Wrap-Up • 80–160 min	393		• BLM 6-20 Chapter 6 Problem Wrap-Up Rubric	• computers with Internet access • graphing calculators
Chapters 5 and 6 Review • 80 min	394–395		• BLM A-13 Self-Assessment Recording Sheet • BLM A-14 Self-Assessment Checklist	• graphing calculators
Chapter 6 Task • 80 min	396–397		• BLM 6-21 Chapter 6 Task Rubric	• computers with Internet access • graphing calculators

Chapter 6 Blackline Masters Checklist

	Title		Purpose
Chapter 6 Opener			
	BLM A-4	Presentation Checklist	Assessment
Prerequisite Skills			
	BLM 6-1	Prerequisite Skills	Practice
	BLM 6-2	Prerequisite Skills Self-Assessment Checklist	Self-Assessment
6.1 Exponent Laws			
	BLM 6-3	Section 6.1 Investigate	Student Support
	BLM 6-4	Section 6.1 Exponent Laws	Practice
	BLM 6-5	Section 6.1 Achievement Check Rubric	Assessment
	BLM T-5	The Computer Algebra System	Technology
6.2 Rational Exponents			
	BLM 6-6	Section 6.2 Rational Exponents	Practice
	BLM 6-7	Section 6.2 Achievement Check Rubric	Assessment
6.3 Represent Exponential Expressions			
	BLM 6-8	Section 6.3 Represent Exponential Expressions	Practice
	BLM 6-9	Section 6.3 Achievement Check Rubric	Assessment
	BLM A-9	Communication General Scoring Rubric	Assessment
6.4 Tools and Strategies to Solve Equations Involving Exponents			
	BLM 6-10	Section 6.4 Investigate	Student Support
	BLM 6-11	Section 6.4 Tools and Strategies to Solve Equations Involving Exponents	Practice
	BLM 6-12	Section 6.4 Achievement Check Rubric	Assessment
6.5 Construct and Apply Exponential Models			
	BLM 6-13	Section 6.5 Warm-Up	Student Support
	BLM 6-14	Section 6.5 Construct and Apply Exponential Models	Practice
	BLM 6-15	Section 6.5 Achievement Check Rubric	Assessment
	BLM A-9	Communication General Scoring Rubric	Assessment
	BLM T-6	Using the CBR™	Technology
Chapter 6 Review			
	BLM 6-16	Chapter 6 Literacy	Review
	BLM 6-17	Chapter 6 Review	Review
Chapter 6 Practice Test			
	BLM 6-18	Chapter 6 Practice Test	Diagnostic Assessment
	BLM 6-19	Chapter 6 Test	Summative Assessment
Chapter 6 Problem Wrap-Up			
	BLM 6-20	Chapter 6 Problem Wrap-Up Rubric	Summative Assessment
Chapters 5 and 6 Review			
	BLM A-13	Self-Assessment Recording Sheet	Assessment
	BLM A-14	Self-Assessment Checklist	Assessment
Chapter 6 Task			
	BLM 6-21	Chapter 6 Task Rubric	Summative Assessment
	BLM 6-22	Chapter 6 BLM Answers	

Prerequisite Skills

Student Text Pages
340–341

Suggested Timing
40–80 min

Tools
- graphing calculators

Related Resources
BLM 6-1 Prerequisite Skills
BLM 6-2 Prerequisite Skills Self-Assessment Checklist

Common Errors

- Some students incorrectly evaluate powers that are multiplied by a negative number or that have a negative base.

R_x Emphasize the placement of brackets and the order of operations. Use examples similar to **question 1, parts b) and d)** to illustrate.

- Some students confuse the product rule and the power of a power rule.

R_x Have students use patterning to see the difference between these rules. Students may benefit from using a CAS graphing calculator.

Accommodations

Memory—have students review how to use the exponent functions on their scientific or graphing calculators

ESL—ask students to record unfamiliar words and terms in their personal math dictionaries. Encourage students to use diagrams, symbols, their first language, or other means of recording and understanding the meaning of the unfamiliar word. Pair them with a classmate who can explain the meanings of new terms, such as *exponent*, *power*, *base*, and *quotient*.

Teaching Suggestions

- Consider having students work through these problems in pairs.
- Write the exponent laws on the board for students who need a reminder. See section 6.1, Key Concepts, page 348.

Assessment

- Assess students' readiness to proceed by informal observation as students are working on the questions. A formal test is inappropriate since this material is not part of the grade 12 curriculum for this chapter.
- Student self-assessment is also an effective technique; students can place a checkmark beside topics in the Prerequisite Skills in which they feel confident with the necessary skills. Use **BLM 6-2 Prerequisite Skills Self-Assessment Checklist** as a self-assessment tool for students.
- Remedial action can be taken in small groups or with a whole class skills review.

Extra Practice

- Use **BLM 6-1 Prerequisite Skills** for extra practice or remediation.

Chapter Problem

- The Chapter Problem is introduced on page 341. Have students discuss their understanding of the topic. You may wish to have students complete the Chapter Problem revisits that occur throughout the chapter. These questions are designed to help students move toward the Chapter 6 Problem Wrap-Up on page 393.
- Alternatively, you may wish to assign the Chapter Problem questions and Chapter Problem Wrap-Up when students have completed the chapter, as part of a summative assessment.