CHAPTER

7

Exponents

Strand
Mathematical Models

Student Text Pages
352–353

Suggested Timing
10 min

Related Resources
BLM A-4 Presentation Checklist

Key Terms

doubling time
exponential decay
exponential growth
exponential relation
half-life

Additional information and teaching materials for this chapter are available on the McGraw-Hill Ryerson Web-site at *www.mcgrawhill.ca/books/foundations11*. You will need your password to access this material.

Chapter Curriculum Specific Expectations

Connecting Graphs and Equations of Exponential Relations

In this chapter, students will

MM2.01 determine, through investigation using a variety of tools and strategies (e.g., graphing with technology; looking for patterns tables of values), and describe the meaning of negative exponents and of zero as an exponent

MM2.02 evaluate, with and without technology, numerical expressions containing integer exponents and rational bases (e.g. 2^{-3}, 6^3, 3456^0, 1.03^{10})

MM2.03 determine, through investigation (e.g., by patterning with and without a calculator), the exponent rules for multiplying and dividing numerical expressions involving exponents [e.g., $\left(\frac{1}{2}\right)^3 \times \left(\frac{1}{2}\right)^3$], and the exponent rule for simplifying numerical expressions involving a power of a power [e.g. $(5^3)^2$]

MM2.04 graph simple exponential relations, using paper and pencil, given their equations [e.g. $y = 2^x$, $y = 10^x$, $y = \left(\frac{1}{2}\right)^x$]

MM2.05 make and describe connections between representations of an exponential relation (i.e., numeric in a table of values; graphical, algebraic)

MM2.06 distinguish exponential relations from linear and quadratic relations by making comparisons in a variety of ways (e.g., comparing rates of change using finite differences in tables of values; inspecting graphs; comparing equations), within the same context when possible (e.g., simple interest and compound interest; population growth)

Solving Problems Involving Exponential Relations

In this chapter, students will

MM3.01 collect data that can be modelled as an exponential relation, through investigation with and without technology, from primary sources, using a variety of tools (e.g., concrete materials such as number cubes, coins; measurement tools such as electronic probes), or from secondary sources (e.g., websites such as Statistics Canada, E-STAT), and graph the data

MM3.02 describe some characteristics of exponential relations arising from real-world applications (e.g., bacterial growth, drug absorption) by using tables of values (e.g., to show a constant ratio, or multiplicative growth or decay) and graphs (e.g., to show, with technology, that there is no maximum or minimum value)

MM3.03 pose and solve problems involving exponential relations arising from a variety of real-world applications (e.g., population growth, radioactive decay, compound interest) by using a given graph or a graph generated with technology from a given equation

MM3.04 solve problems using given equations of exponential relations arising from a variety of real-world applications (e.g., radioactive decay, population growth, height of a bouncing ball, compound interest) by substituting values for the exponent into the equations

Teaching Suggestions

Chapter Opener

- Introduce the topic of exponential relations by asking students how linear and quadratic relations compare. Mention that there are other types of relations, including exponential relations.
- Ask students to explain the difference between 2^5 and 5^2. Look for the meanings of the base and the exponent.
- Engage students in a discussion of careers that use exponential relations, such as a medical laboratory technologist. This can also lead into the Chapter Problem, which focuses on audiology technicians.

Career Profile

Have students discuss what they know about medical lab technicians. As an extension, have students research this career and other similar careers, and present their findings to the class. You may wish to use **BLM A-4 Presentation Checklis**t to assess students' presentations.

Using their research, have students discuss:

- What a medical laboratory technician does.
- What type of education and training are needed for this career.
- Another career that is similar.
- The differences in the training and education required for the similar career.

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

For more career resources for your students, see the McGraw-Hill Ryerson Web-site at *www.mcgrawhill.ca/books/foundations11*.

Chapter 7 Planning Chart

Section Suggested Timing	Student Text Page(s)	Teacher's Resource Blackline Masters	Assessment	Tools
Chapter 7 Opener • 10 min	352–353		• BLM A-4 Presentation Checklist	
Prerequisite Skills • 40–80 min	354–355	• BLM 7-1 Prerequisite Skills • BLM G-1 Grid Paper	• BLM 7-2 Prerequisite Skills Self-Assessment Checklist	• grid paper
7.1 Exponent Rules • 80 min	356–363	• BLM 7-3 Section 7.1 Exponent Rules		• calculators
7.2 Zero and Negative Exponents • 80 min	364–371	• BLM 7-4 Section 7.2 Zero and Negative Exponents		• calculators
7.3 Investigate Exponential Relationships • 160 min	372–381	• BLM 7-5 Section 7.3 Investigate Exponential Relationships • BLM 7-6 Section 7.3 Analogue Radio Dial • BLM G-1 Grid Paper	• BLM 7-7 Section 7.3 Achievement Check Rubric	• paper • grid paper • temperature probe • hot water • large bowl
7.4 Exponential Relations • 80–160 min	382–394	• BLM 7-8 Section 7.4 Exponential Relations • BLM 7-9 Section 7.4 Literacy Connect • BLM G-1 Grid Paper	• BLM A-18 Opinion Piece Checklist	• graphing calculators • grid paper
7.5 Modelling Exponential Growth and Decay • 80–160 min	395–405	• BLM 7-10 Section 7.5 Modelling Exponential Growth and Decay	• BLM 7-11 Section 7.5 Achievement Check Rubric • BLM T-6 The CBR™	• graphing calculators • CBR™ • basketball or volleyball
7.6 Solve Problems Involving Exponential Growth and Decay • 80 min	406–413	• BLM 7-12 Section 7.6 Solve Problems Involving Exponential Growth and Decay • BLM G-1 Grid Paper	• BLM A-9 Communication General Scoring Rubric	• dice, number cubes, or spinners • calculators • grid paper • graphing calculators
Chapter 7 Review • 80 min	414–415	• BLM 7-13 Chapter 7 Review • BLM G-1 Grid Paper		• grid paper • graphing calculators
Chapter 7 Practice Test • 40–80 min	416–417	• BLM G-1 Grid Paper	• BLM 7-14 Chapter 7 Practice Test • BLM 7-15 Chapter 7 Test	• grid paper • graphing calculators
Chapter 7 Problem Wrap-Up • 30 min	417		• BLM 7-16 Chapter 7 Problem Wrap-Up Rubric	

Chapter 7 Blackline Masters Checklist

	Title		Purpose
Chapter 7 Opener			
	BLM A-4	Presentation Checklist	Assessment
Prerequisite Skills			
	BLM 7-1	Prerequisite Skills	Practice
	BLM 7-2	Prerequisite Skills Self-Assessment Checklist	Self-Assessment
	BLM G-1	Grid Paper	Student Support
7.1 Exponent Rules			
	BLM 7-3	Section 7.1 Exponent Rules	Practice
7.2 Zero and Negative Exponents			
	BLM 7-4	Section 7.2 Zero and Negative Exponents	Practice
7.3 Investigate Exponential Relationships			
	BLM 7-5	Section 7.3 Investigate Exponential Relationships	Practice
	BLM 7-6	Section 7.3 Analogue Radio Dial	Student Support
	BLM 7-7	Section 7.3 Achievement Check Rubric	Assessment
	BLM G-1	Grid Paper	Student Support
7.4 Exponential Relations			
	BLM 7-8	Section 7.4 Exponential Relations	Practice
	BLM 7-9	Section 7.4 Literacy Connect	Literacy
	BLM G-1	Grid Paper	Student Support
7.5 Modelling Exponential Growth and Decay			
	BLM 7-10	Section 7.5 Modelling Exponential Growth and Decay	Practice
	BLM T-6	The CBR™	Student Support
	BLM 7-11	Section 7.5 Achievement Check Rubric	Assessment
7.6 Solve Problems Involving Exponential Growth and Decay			
	BLM 7-12	Section 7.6 Solve Problems Involving Exponential Growth and Decay	Practice
	BLM G-1	Grid Paper	Student Support
	BLM A-9	Communication General Scoring Rubric	Assessment
Chapter 7 Review			
	BLM 7-13	Chapter 7 Review	Review
	BLM G-1	Grid Paper	Student Support
Chapter 7 Practice Test			
	BLM 7-14	Chapter 7 Practice Test	Diagnostic Assessment
	BLM 7-15	Chapter 7 Test	Summative Assessment
	BLM G-1	Grid Paper	Student Support
Chapter 7 Problem Wrap-Up			
	BLM 7-16	Chapter 7 Problem Wrap-Up Rubric	Summative Assessment

Prerequisite Skills

Student Text Pages
354–355

Suggested Timing
40–80 min

Tools
- grid paper

Related Resources
BLM 7-1 Prerequisite Skills
BLM 7-2 Prerequisite Skills Self-Assessment Checklist
BLM G-1 Grid Paper

Common Errors

- Some students may have difficulty working with powers with negative bases, with or without brackets.

R_x Have students understand the role of a set of brackets. Have them find the product (–3)(–3) and compare the sign to the product (–3)(–3)(–3). In addition, explain that, without brackets, the negative sign applies to the whole power, not the base. For example, $-3^2 = -(3)(3)$.

- Some students may mix up slope and *y*-intercept.

R_x Remind students that the slope of a linear relation is the rate of change of the relation, so it modifies or "goes with" the variable *x*. The *y*-intercept is the initial or fixed value, so it is a constant. Students could also graph a few linear relations and identify the slope and *y*-intercept from the graphs.

Accommodations

Perceptual—provide large sheets of grid paper for questions 4 and 8

Visual—provide an enlarged photocopy of questions 1 and 2

Teaching Suggestions

- As these topics have been covered in previous lessons, a diagnostic approach can be taken. Ask students to write down how much they remember about each topic. Go over their lists and discuss the key concepts before assigning the exercise. Take up questions every few minutes to give immediate feedback.
- Stronger students may only need to do a few parts of each question. Students who are having difficulty may benefit from the additional practice of completing all the questions.
- Distribute copies of **BLM G-1 Grid Paper**.
- All BLMs referred to throughout this chapter can be found on the *Foundations for College Mathematics 11 Teacher's Resource* CD-ROM.

Assessment

- Assess student readiness to proceed by informal observation as students are working on the questions. A formal test would be inappropriate since this material is not part of the grade 11 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 7-2 Prerequisite Skills Self-Assessment Checklist** as a self-assessment for students.
- Remedial action can be taken in small groups or with a whole-class skills review.

Extra Practice

- Use **BLM 7-1 Prerequisite Skills** for extra practice or remediation.

Chapter Problem

- The Chapter Problem is introduced on page 355. Have students discuss their understanding of possible causes of hearing loss. You may wish to have students research the career for their career portfolio. 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 7 Problem Wrap-Up on page 417.
- 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.