3

Quadratic Functions

General Outcome

Develop algebraic and graphical reasoning through the study of relations.

Specific Outcomes

RF3 Analyze quadratic functions of the form $y = a(x - p)^2 + q$ and determine the:
- vertex
- domain and range
- direction of opening
- axis of symmetry
- x- and y-intercepts.

RF4 Analyze quadratic functions of the form $y = ax^2 + bx + c$ to identify characteristics of the corresponding graph, including:
- vertex
- domain and range
- direction of opening
- axis of symmetry
- x- and y-intercepts

and to solve problems.

By the end of this chapter, students will be able to:

Section	Understanding Concepts, Skills, and Processes
3.1	✓ identify quadratic functions in vertex form
	✓ determine the effect of a, p, and q on the graph of $y = a(x - p)^2 + q$
	✓ analyse and graph quadratic functions using transformations
3.2	✓ identify quadratic functions in standard form
	✓ determine the vertex, domain and range, axis of symmetry, maximum or minimum value, and x-intercepts and y-intercept for quadratic functions
	✓ graph and analyse quadratic functions in standard form
3.3	✓ convert quadratic functions from standard to vertex form
	✓ analyse quadratic functions of the form $y = ax^2 + bx + c$
	✓ write quadratic functions to model situations

Assessment	Supporting Learning
Assessment *as* Learning	
Use the Before column of **BLM 3–1 Chapter 3 Self-Assessment** to provide students with the big picture for this chapter and help them identify what they already know, understand, and can do. You may wish to have students keep this master in their math portfolio and refer to it during the chapter.	• During work on the chapter, have students keep track of what they need to work on. They can check off each item as they develop the skill or process at an appropriate level.
Assessment *for* Learning	
Method 1: Use the introduction on page 140 in *Pre-Calculus 11* to activate students' prior knowledge about the skills and processes that will be covered in this chapter. **Method 2:** Have students develop a journal entry to explain what they personally know about functions. You might provide the following prompts: • Have you ever seen graphs of linear functions in your everyday life? Where? • What kinds of situations did these graphs represent?	• Have students use their list of what they need to work on to keep track of the skills and processes that need attention. They can check off each item as they develop the skill or process at an appropriate level. • Students who require activation of prerequisite skills may wish to complete **BLM 3–2 Chapter 3 Prerequisite Skills**. This material is on the Teacher CD of this Teacher's Resource and mounted on the www.mhrprecalc11.ca book site.
Assessment *as* Learning	
As students work on each section in Chapter 3, have them keep track of any problems they are having.	• As students complete each section, have them review the list of items they need to work on and check off any that have been handled. • Encourage students to write definitions for the Key Terms in their own words, including reminder tips that may be helpful for review throughout the chapter. • Encourage students to write examples of their own in their notebook or math portfolio. Students should have an example for each method that is covered in the chapter.
Assessment *for* Learning	
BLM 3–3 Chapter 3 Warm-Up This reproducible master includes a warm-up to be used at the beginning of each section. Each warm-up provides a review of prerequisite skills needed for the section.	• As students complete questions, note which skills they are retaining and which ones may need additional reinforcement. • Use the warm-up to provide additional opportunities for students to demonstrate their readiness for the chapter material. • Have students share their strategies for completing mathematics calculations.

Chapter 3 Planning Chart

Section/ Suggested Timing	Prerequisite Skills	Materials/Technology	Teacher's Resource Blackline Masters	Exercise Guide	Assessment		
					Assessment *as* Learning	Assessment *for* Learning	Assessment *of* Learning
Chapter Opener • 20–30 min (TR page 101)	Students should be familiar with • functions and function notation • graphing linear functions • characteristics of graphs of linear relations, such as intercepts, slope, domain, and range • factoring trinomials		BLM 3–1 Chapter 3 Self-Assessment BLM 3–2 Chapter 3 Prerequisite Skills BLM U2–1 Unit 2 Project Checklist				
3.1 Investigating Quadratic Functions in Vertex Form • 120–180 min (TR page 103)	Students should be familiar with • functions and function notation • graphing linear functions • characteristics of graphs of linear relations, such as intercepts, slope, domain, and range • set notation	• grid paper • ruler • graphing calculator • graphing software (optional)	Master 2 Centimetre Grid Paper Master 3 0.5 Centimetre Grid Paper BLM 3–3 Chapter 3 Warm-Up BLM 3–4 Section 3.1 Extra Practice	**Essential:** #1, 2a), b), 3a), c), 4, 6, 7, 8a)–c), 9, 11, 21, 24, 25 **Typical:** #2, 4, 5, 7, 9, 12–14, 16, 18, one of 17, 19, or 20, 24–26 **Extension/Enrichment:** #7, 12–14, 18, 21–26	TR pages 105, 112	TR pages 109, 112	
3.2 Investigating Quadratic Functions in Standard Form • 100–120 min (TR page 113)	Students should be familiar with • quadratic functions in vertex form • graphing quadratic functions • writing quadratic functions	• grid paper • ruler • calculator or graphing calculator • graphing software (optional) • 100-cm length of string (optional)	Master 2 Centimetre Grid Paper Master 0.5 Centimetre Grid Paper BLM 3–3 Chapter 3 Warm-Up BLM 3–5 Section 3.2 Extra Practice TM 3–1 How to Do Page 168 Example 2 Using TI-Nspire™ TM 3–2 How to Do Page 168 Example 2 Using TI-83/84 TM 3–3 How to Do Page 168 Example 2a) Using Microsoft® *Excel* TM 3–4 How to Do Page 168 Example 2a) Using *The Geometer's Sketchpad®* TM 3–5 How to Do Page 168 Example 2a) Using *GeoGebra* TM 3–6 How to Do Page 174 #5a) Using TI-Nspire™ TM 3–7 How to Do Page 174 #5a) Using TI-83/84 TM 3–8 How to Do Page 179 #27 Using *The Geometer's Sketchpad®* TM 3–9 How to Do Page 179 #27 Using *GeoGebra*	**Essential:** #1–3, 4a), b), 5a), b), 7, 9, 10, 12, 13, 26, 27 **Typical:** #1–8, 10, 11, 12, four of 14–21, 26, 27 **Extension/Enrichment:** #15, 16, 20–26	TR pages 115, 124	TR pages 119, 124	
3.3 Completing the Square • 100–150 min (TR page 125)	Students should be familiar with • multiplying polynomials • factoring trinomials • quadratic functions in standard form • graphing quadratic functions • determining characteristics of graphs of quadratic functions	• grid paper • ruler • graphing calculator • graphing software (optional) • algebra tiles	Master 2 Centimetre Grid Paper Master 3 0.5 Centimetre Grid Paper Master 4 Algebra Tiles (Positive Tiles) Master 5 Algebra Tiles (Negative Tiles) BLM 3–3 Chapter 3 Warm-Up BLM 3–6 Section 3.3 Extra Practice	**Essential:** #1a), b), 2a), b), 3, 4a), b), 5a), d), 7a)–c), 8a), b), 9, 12, 14, 29, 30 **Typical:** #1, 3, 5–12, two of 13, 16, 17, three of 18–24, 29, 30 **Extension/Enrichment:** #12, 17, 23–31	TR pages 127, 133	TR pages 130, 131, 133	
Chapter 3 Review • 60–90 min (TR page 134)		• grid paper • ruler • graphing calculator • graphing software (optional) • algebra tiles	Master 2 Centimetre Grid Paper Master 3 0.5 Centimetre Grid Paper Master 4 Algebra Tiles (Positive Tiles) (optional) Master 5 Algebra Tiles (Negative Tiles) (optional) BLM 3–4 Section 3.1 Extra Practice BLM 3–5 Section 3.2 Extra Practice BLM 3–6 Section 3.3 Extra Practice	Have students do at least one question related to any concept, skill, or process that has been giving them trouble.		TR page 134	
Chapter 3 Practice Test • 45–60 min (TR page 135)		• grid paper • ruler • graphing calculator • graphing software (optional) • algebra tiles	Master 2 Centimetre Grid Paper Master 3 0.5 Centimetre Grid Paper Master 4 Algebra Tiles (Positive Tiles) (optional) Master 5 Algebra Tiles (Negative Tiles) (optional) BLM 3–7 Chapter 3 Test BLM 3–8 Chapter 3 BLM Answers	Provide students with the number of questions they can comfortably do in one class. Choose at least one question for each concept, skill, or process. **Minimum:** #2–8, 10–12	TR page 136		TR page 136 BLM 3–7 Chapter 3 Test