8.1 Interpret Quadratic Relations

Strand
Quadratic Relations of the Form $y = ax^2 + bx + c$

Student Text Pages
320–328

Suggested Timing
80–160 min

Tools
- graphing calculators

Related Resources
BLM 8.1.1 Practice: Interpret Quadratic Relations
BLM 8.1.2 Achievement Check Rubric

Specific Expectations

Solving Problems by Interpreting Graphs of Quadratic Relations

In this section, students will

QR3.01 solve problems involving a quadratic relation by interpreting a given graph or a graph generated with technology from its equation

Link to Get Ready

Students should complete all the questions in the Get Ready before proceeding with Section 8.1.

Warm-Up

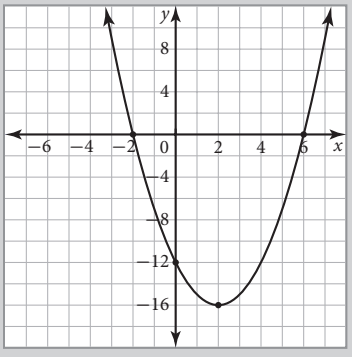
1. Evaluate each quadratic expression for $x = -2$.

a) $3x^2 + 15x$

b) $-x^2 + 6x + 27$

c) $(2x - 5)^2$

2. Consider this parabola:



a) Identify the coordinates of the vertex.

b) Identify the maximum or minimum.

c) Identify the x- and y-intercepts.

3. Consider this quadratic relation:

x	y
3	−32
4	−14
5	0
6	10
7	16
4	18
9	16
10	10
11	0
12	−14
13	−13

a) Identify the coordinates of the vertex.

b) Identify the maximum or minimum.

c) Identify the zeros.

Common Errors

- Some students may state the x-coordinate of the vertex as the maximum/minimum value of a quadratic relation.

R_x Explain to students that the maximum or minimum is the maximum or minimum value of the dependent variable, which is always plotted on the vertical axis.

Ongoing Assessment

- While students are working on the Investigate, circulate to see how well each student works within a group. This may be an opportunity to begin observing and recording individual students' learning skills: group work, work habits, organization, and initiative.
- By this time, students should be very familiar with graphing calculators. TI-SmartView™ can be used to take up the Investigate as a class.

Accommodations

Gifted and Enrichment—Have students research to learn more about the cube houses discussed in the Section Opener.

Spatial—Some students may benefit from using cubes to complete the Investigate.

Warm-Up Answers

1. a) -18 **b)** 11 **c)** 81

2. a) $(2, -16)$
b) minimum at -16
c) x-intercepts: -2 and 6; y-intercept: -12

3. a) $(4, 18)$ **b)** maximum at 18 **c)** 5 and 11

Teaching Suggestions

Warm-Up

- Write the Warm-Up questions on the board or on an overhead. Have students complete the questions independently. Then, discuss the solutions as a class. (10–15 min)

Section Opener

- Read the Section Opener as a class.
- You may wish to bring larger pictures of the Kubuswoning (cube houses) for the students. Alternatively, ask interested students to research in the library or on the Internet for images and information on the Kubuswoning and report their findings back to the class.

Investigate

- Encourage students to work with a partner to complete the Investigate.
- When students have completed the Investigate, invite volunteers to share their results with the class.
- Some students may wish to use cubes to build models of the cubes with different side lengths.
- Use **BLM 8.1.1 Practice: Interpret Quadratic Relations** for extra practice or remediation.

Investigate Answers (pages 320–321)

1. a)

Side Length (cm)	Surface Area (cm^2)
1	6
2	24
3	54
4	96
5	150
6	216

2. b) The points lie on a curve that appears to be half a parabola.
c) $y = 6x^2$

3. a) 600 cm^2 **b)** 2904 cm^2 **c)** 384 cm^2

4. A quadratic relation can be represented by an equation of the form $y = ax^2 + bx + c$, where a can be any number except 0. To find the surface area of a cube, you must square the side length, x, then multiply by 6 because there are 6 congruent faces.

Examples

- For Example 1, ask students, "From what height above the ground was the ball thrown?" or "Was the ball thrown from the ground? Explain."
- For Example 2, have students enter the equation on a graphing calculator and follow the instructions. For extra practice, students can find the heights of other support posts installed at different distances from the foot of the arch (e.g., 10', 20', 60', 80').

Key Concepts

- With the class, discuss whether a relation of the form $y = ax^2 + bx + c$ is quadratic if $b = 0$ or if $c = 0$ and $b \neq 0$.
- Ask students, "What are the two ways of solving problems using quadratic relations?" (Answer: the graph, the equation)

Discuss the Concepts

- Have students read the questions and record their solutions before starting a class discussion.

Discuss the Concepts Suggested Answers (page 323)

D1. An advantage to using a graph is that you can quickly estimate the maximum or minimum value, the zeros, and the *y*-intercept. A disadvantage is that you cannot obtain accurate answers unless you use a graphing calculator.

D2. When the equation or the values to be substituted involve decimal numbers, it is easier and more accurate to use the equation. For example, in Example 1, the height of the ball after 2 s appears to be 4 m but this is only an estimate.

Practise the Concepts (A)

- Encourage students to refer back to the Examples before asking for assistance.
- Have grid paper and graphing calculators available for students who wish to use them.
- Have students complete these questions individually.

Apply the Concepts (B)

- This is a good time to assess informally how well students use a graphing calculator and interpret quadratic relations in real-life situations.
- For questions 4 to 8, students should use the QuadReg function on a graphing calculator to find the equation of the parabola that fits the data.
- Question 7 is a Literacy Connect. Literacy Connect questions offer the opportunity to explore literacy issues in the mathematics classroom and within the context of mathematics. This supports general Think Literacy strategies. For more information visit http://www.edu.gov.on.ca/eng/studentsuccess/thinkliteracy.
- You may wish to assign Question 9 as homework to be handed in the next day.
- Question 11 is a Chapter Problem. Remind students to keep the solution to this question handy as it may help them with the Chapter Problem Wrap-Up.
- Question 12 is an Achievement Check. It can be used as a form of diagnostic or formative assessment, or assigned as a small summative assessment piece. This provides an opportunity for formative or self-assessment, using **BLM 8.1.2 Achievement Check Rubric**.

Achievement Check Answers (page 328)

12. a) $y = 4.976x^2 - 1.94x + 70$

b) The y-intercept models the diver's initial height, which was 70 m.

c) When the diver hits the water, his or her height is 0. The diver hits the water after approximately 3.6 s.

Extend the Concepts (C)

- Assign the Extend the Concepts questions to students who are not being challenged by questions in Apply the Concepts.
- Extend the Concepts questions can be used as a diagnostic assessment for those students considering a university-level course in grade 11.
- Question 13 leads into the next section of the chapter. It also reinforces the concepts of expanding and factoring.