4.5 Interpret Graphs of Quadratic Relations

Student Text Pages
218–225

Suggested Timing
80 min

Tools
- grid paper
- graphing calculators
- computers
- *The Geometer's Sketchpad®*

Related Resources
BLM 4-9 Section 4.5 Interpret Graphs of Quadratic Relations
BLM 4-10 Section 4.5 Investigate
BLM G-1 Grid Paper

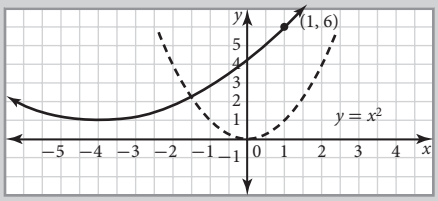
Link to Prerequisite Skills

Questions 1 to 7 are good for calculations and algebraic skills. Question 11 requires students to interpret information from a graph. Question 12 reminds students of transformations.

Warm-Up

1. Describe the parabola defined by each quadratic relation.
a) $y = 4(x - 15)^2 + 10$ **b)** $y = -0.2x^2 - 6$

2. Write an equation for the solid-line parabola.



Warm-Up Answers

1. a) The parabola opens upward. It is stretched vertically by a factor of 4 and the coordinates of the vertex are (15, 10).

b) The parabola opens downward. It is compressed vertically and the coordinates of the vertex are (0, –6).

2. The parabola opens upward and is compressed vertically, so $0 < a < 1$. The coordinates of the vertex are (–4, 1). So, the equation has the form $y = a(x + 4)^2 + 1$. Use the fact that the parabola passes through (1, 6) to find the value of a. The equation is $y = 0.2(x + 4)^2 + 1$.

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.

Section Opener

- Read the opening paragraph aloud. Ask students to think of other applications for modelling projectile motion.

Examples

- Work through the Examples as a class. Alternatively, have students complete the Examples independently or in small groups before reviewing them as a class.
- The Examples show some situations that can be modelled by quadratic relations. They show formula manipulation and substitution techniques for solving these types of problems.
- Additional questions for Example 1:
  1. What relation could you use to calculate the distance the wrench has fallen? Use the answer in part c) of Example 1 to explain.

2. Draw a graph to represent how far the wrench has fallen. Compare this graph to the graph in part a).

Key Concepts

- You may want to clarify that the origin can be moved to a convenient place (such as the vertex) when modelling a situation with a quadratic relation.

Discuss the Concepts

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

Discuss the Concepts Suggested Answers (page 222)

D1. Use the vertex and another point to solve for a. Then, write the relation using the coordinates of the vertex and the value of a.

D2. The coordinates of the vertex and the coefficient a.

Practise (A)

- Encourage students to review the Examples before asking for assistance.
- Have copies of **BLM G-1 Grid Paper** available.

Apply (B)

- **Question 5** is a Literacy Connect question, which provides students an opportunity to explore literacy in the context of mathematics. For **part c)**, ensure students understand the first second refers to the interval between 0 s and 1 s and the fourth second refers to the interval between 3 s and 4 s.
- For **question 6**, students can assume the vertex is at the origin.
- **Question 8** links to the Chapter Problem. Remind students to keep their solution to this problem handy to help them when they complete the Chapter Problem Wrap-Up.

Extend (C)

- Assign the Extend question to students who are not being challenged by the Apply questions.
- Give this question to students interested in using *The Geometer's Sketchpad®* to solve a complex problem. Go to *www.mcgrawhill.ca/books/foundations11* and follow the links to download the file **4.5 Basketball.gsp** to share with students.

  Question: A basketball player is making a shot 11 m away from the net. The path of the ball can be modelled by the equation,

  $h = \frac{-4.9}{(V\cos\theta)^2}d^2 + (\tan\theta)d + R$ where V is the initial velocity of the ball in metres per second, θ is the angle of the shot, h is the height above the ground, R is the release height, and d is the horizontal distance from the player, all in metres. If the maximum release height of the player is 3 m and the maximum velocity he can shoot is 11 m/s, is it possible for him to make the shot?

  Use the file to find values for the release height, the angle, and the velocity. Then use the formula to verify your answer.

  Answer: Yes, he will make the shot using an angle of approximately 60°.

Common Errors

- Some students do not know where to begin when solving word problems.

R_x Have students read the questions carefully and identify the given information and the required information. Remind them to look for similar questions in the Investigates and Examples to help them get started.

Accommodations

Gifted and Enrichment—have students complete the investigation on **BLM 4-10 Section 4.5 Investigate**. Go to *www.mcgrawhill.ca/books/foundations11* and follow the links to download the file **4.5 Investigation.gsp**.

Memory—encourage students to refer to their graphic organiser

Visual—have students use a graphing calculator or other graphing tool to construct graphs

Spatial—have students prepare a set of index cards showing the algebraic steps for solving an equation or finding the vertex of a parabola

Mathematical Process Expectations

Process Expectation	Questions
Problem Solving	6, 9, 10
Reasoning and Proving	1–3, 6–8
Reflecting	5, 7–9
Selecting Tools and Computational Strategies	1, 4, 5, 7, 9, 10
Connecting	5, 8–10
Representing	5, 8
Communicating	6–9

Ongoing Assessment

You may wish to collect students' responses to the Discuss the Concepts questions.

Extra Practice

- You may wish to use **BLM 4-9 Section 4.5 Interpret Graphs of Quadratic Relations** for extra practice or remediation.