6.1 Explore Non-Linear Relations

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

Student Text Pages
238–244

Suggested Timing
80 min

Tools
• grid paper

Related Resources
BLM 6.1.1 Practice: Explore Non-Linear Relations
BLM A3 Communication General Scoring Rubric
BLM G1 Grid Paper

Specific Expectations

Identifying Characteristics of Quadratic Relations

In this section, students will

QR2.03 identify the key features of a graph of a parabola (i.e., the equation of the axis of symmetry, the coordinates of the vertex, the *y*-intercept, the zeros, and the maximum or minimum value), using a given graph or a graph generated with technology from its equation, and use the appropriate terminology to describe the features

Link to Get Ready

The Investigate requires students to plot ordered pairs. Have students complete questions 2 and 3 of the Get Ready before proceeding with Section 6.1.

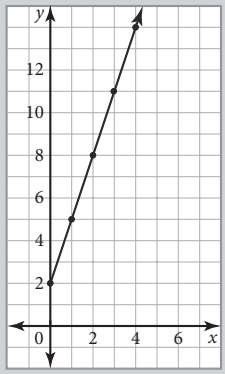
Warm-Up

Plot the ordered pairs in each set on a coordinate grid, then draw the line or curve of best fit.

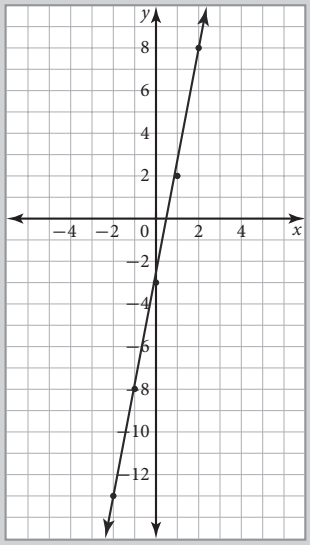
a) (4, 14), (3, 11), (2, 8), (1, 5), (0, 2)
b) (−2, −13), (−1, −8), (0, −3), (1, 2), (2, 8)
c) (−3, −17), (−2, −7), (−1, −1), (0, 1), (3, −17), (2, −7), (1, −1)

Warm-Up Answers

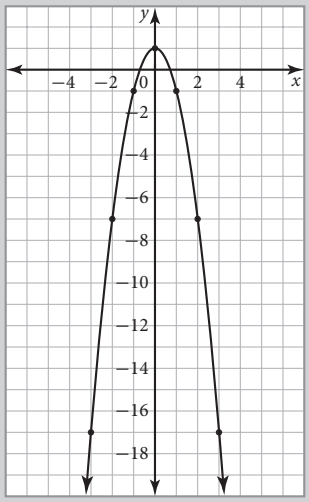
a)



b)



c)



Common Errors

- Some students may draw a V-shape when connecting the points.

R_x Point out the picture in the section opener as well as other curved shapes indicating that this shape models the data best.

Ongoing Assessment

- Consider using Apply the Concepts question 2 as a class discussion, and assess students' communication skills. You may wish to use **BLM A3 Communication General Scoring Rubric** to assist you in assessing your students.
- While students are working on the Investigate, circulate to see how well they work. This may be an opportunity to begin observing and recording the individual student's learning skills.

Accommodations

Gifted and Enrichment—Have students identify the relation in question 7 as an exponential relation. Ask them to explore how the relation changes as the base of the power changes.

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. (5–10 min) Review with students how to draw the rectangles and the coordinate grid. Students may try to draw two straight lines in the form of an inverted V for part c). Take some time to show them that drawing a smooth curve works best.

Section Opener

- The Section Opener shows a structure that is parabolic in shape. You may wish to have students brainstorm other manufactured or naturally occurring structures that have similar shapes before proceeding with the Investigate.

Investigate

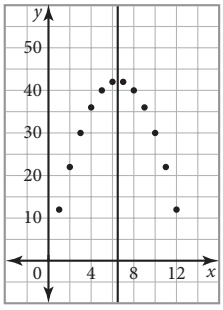
- Have students read the Key Terms before proceeding with the Investigate.
- You may wish to use **BLM G1 Grid Paper** for this activity.
- Follow the Investigate with a discussion about the shape of the graph.
- Use **BLM 6.1.1 Practice: Explore Non-Linear Relations** for extra practice or remediation.

Investigate Answers (page 238)

1. Students should draw a rectangle with each set of dimensions.

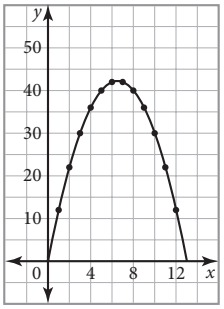
Length (units)	Width (units)	Area (square units)
1	12	12
2	11	22
3	10	30
4	9	36
5	8	40
6	7	42
7	6	42
8	5	40
9	4	36
10	3	30
11	2	22
12	1	12

2–3.



The line does not fit the data at all. It does not pass through any of the points.

4. a)



b) The graph has the shape of an upside down U. It is symmetrical.

5. From the graph, the area of a rectangle with length 2.5 units is about 26 square units.

Examples

- For Example 2, you may need to review the properties of isosceles triangles and right isosceles triangles. In this case, the length of the hypotenuse is not needed.

Key Concepts

- Ask what is meant by "non-linear." Have students give an example of other non-linear graphs (circle).

Discuss the Concepts

- For D1 and D2, ensure students understand the differences between the graphs and tables of values of a linear relation and of a quadratic relation.

Discuss the Concepts Suggested Answers (page 240)

D1. The graph of a linear relation is always a straight line. The graph of a quadratic relation is not a straight line. It is a symmetrical, U-shaped curve.

D2. For both tables, the x-values increase by ones from 0 to 8. In part a), the y-values increase by 2 each time. In part b), the y-values decrease and then increase.

Practise the Concepts (A)

- Encourage students to refer back to the Examples before asking for assistance.
- For question 1, you may wish to use **BLM G1 Grid Paper**.

Apply the Concepts (B)

- For question 5, some students may need to complete the table to 15 rows to answer part d). Encourage students to identify patterns [$P = 2B + 2$, $A = \frac{1}{2}(B)(B + 1)$] and use the patterns to answer part d).
- For question 7, the relation is neither linear nor quadratic. It is an exponential function, $y = 2^x$.
- For question 8, depending on their choice of horizontal and vertical scales, some students may need to estimate the answer to part d).

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.
- For question 9, parts a) to e) should be manageable for all students. Parts f) and g) can be used to help distinguish level 3 and 4 students.
- Ensure that students read the MathConnect before proceeding with the question.