1.1 Power Functions

Student Text Pages
4 to 14

Suggested Timing:
45–65 min

Tools
- grid paper
- graphing calculator

Related Resources
- G–1 Grid Paper
- G–2 Placemat
- BLM 1–2 Section 1.1 Summary
- BLM 1–3 Section 1.1 Practice

Ongoing Assessment

Use **Assessment Masters A–1** to **A–7** to remind students about the Math Processes expectations and how you may be assessing their integrated use of them.

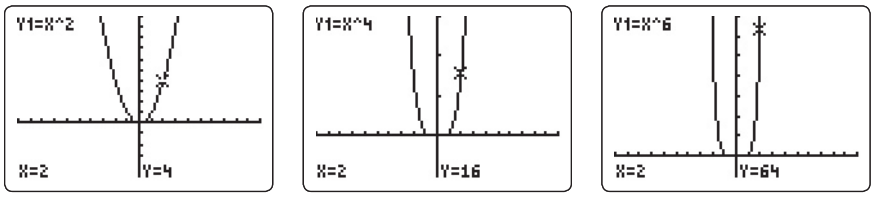
Teaching Suggestions

- Have students read page 4. Ask them to provide other examples of formulas or functions that represent power functions. Discuss the terminology in the box. Be sure to have them identify the difference between a polynomial expression and function.
- Allow students to work individually or in pairs to complete the **Investigate**. Though a graphing calculator is useful to graph the functions or view the table values, it is also possible to use the equations to find points that correspond to each graph in the text. For instance, $y = x^4$ passes through the point (2, 16) and corresponds to graph iii).
- Discuss the use of interval notation that follows **Example 1**. The table on page 8 provides a thorough summary of different ways to express an interval. You may wish to provide a corresponding example for each row using $a = -3$ and $b = 4$.
- Discuss the similarity and difference in the shape of the graph of a quadratic function and the quartic function. Point out that a quartic flattens out near the vertex because for values of x near the vertex, the degree 4 causes the y-values to be closer to 0 than degree 2. For instance, for $x = 0.1$, $y = 0.1^2 = 0.01$ but $y = 0.1^4 = 0.001$.
- Refer to the explanations in the margin features on page 6 when discussing end behaviour, and symmetry in **Example 2**.
- In **Example 3**, point out that power functions with even exponents extend in quadrants that are side-by-side (2 and 1 or 3 and 4), while those with odd exponents extend in quadrants that are opposite each other (3 and 1 or 2 and 4).
- **Example 4** allows for reflection and reasoning to take place for students to determine the similarities and differences that occur between the two graphs. Tools have to be selected to represent the graph required and connecting skills from earlier strands in mathematics will enable the graph to be drawn and the domain, the range, the similarities, and the differences to be discussed through communicating skills.
- Give **BLM 1–2 Section 1.1 Summary** to students to use as a reference/memory aid.
- Use **Communicate Your Understanding** questions C2 and C3 to draw out how the degree of a power function and the value of the leading coefficient effect the shape and end behaviour of the corresponding graph.
- Before completing **question 7**, ask students to sketch examples and discuss features of graphs of periodic and exponential functions on the board.
- **Questions 8** and **9** provide an opportunity to investigate examples involving the sum and difference of power functions.
- **Question 8** requires students to represent three graphs on the same set of axes. They will have to select the necessary tools and use connecting skills to draw the three graphs. They will then have to use their reasoning skills to establish a comparison among the graphs and to communicate the comparison and a description of the key features of the graphs of the functions.
- The use of technology may benefit some students as they complete **questions 10** and **11**. These exercises should help students make the connection between simple and more complex power functions with odd degree or even degree.
- **Question 12** introduces some basic transformations of power functions. These will be covered in-depth in later sections of this chapter.

6.

Key Features of the Graph	$y = x^n$, n is odd	$y = x^n$, n is even
Domain	$\mathbb{R}$	$\mathbb{R}$
Range	$\mathbb{R}$	$\{y \in \mathbb{R}, y \geq 0\}$
Symmetry	point	line
End behaviour as $x \to \infty$	$y \to \infty$	$y \to \infty$
End behaviour as $x \to -\infty$	$y \to -\infty$	$y \to \infty$

7. a)

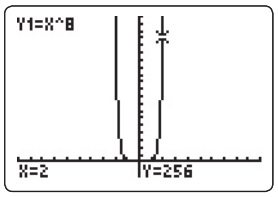


b) Answers may vary. Sample answer: similarities: domain, range, x-intercept, y-intercept, vertex, minimum, end behaviour, line symmetry; differences: shape

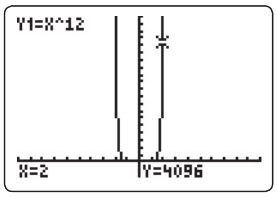
c) Answers may vary. Sample answer: narrower

d) Answers may vary. Sample answer:

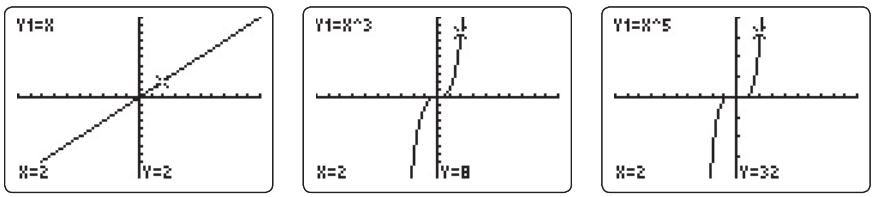
i)



ii)



8. a)

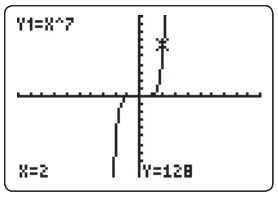


b) Answers may vary. Sample answer: Similarities: domain, range, x-intercept, y-intercept, point symmetry, end behaviour; Differences: narrower

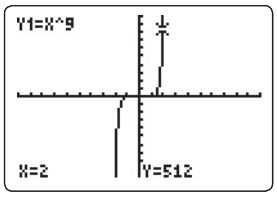
c) Answers may vary. Sample answer: narrower

d) Answers may vary. Sample answer:

i)



ii)



Communicate Your Understanding Responses (page 11)

C1. Answers may vary. Sample answer: $y = 3$ is a constant power function of the form $f(x) = ax^n$ where $a = 3$ and $n = 0$.

C2. Answers may vary. Sample answer: If the leading coefficient is negative the graph is reflected in the x-axis. The end behaviour of the graph will be from quadrant 2 to 4 (odd degree) or quadrant 3 to 4 (even degree).

C3. Answers may vary. Sample answer: The end behaviour indicates the degree of the function. If the graph extends from quadrant 2 to 1 or quadrant 3 to 4 the function is of even degree. If the graph extends from quadrant 3 to 1 or quadrant 2 to 4 the function is of odd degree.

C4. Answers may vary. Sample answers:

a) $y = x^3$ **b)** $y = x^2$ **c)** $y = -x^3$ **d)** $y = -x^2$

Differentiated Instruction

Use **placemat** to review previous work on functions (linear, quadratic).

Build a **word wall/information wall** for terminology in this chapter.

Common Errors

- Students confuse the bracket notation for intervals (a, b) with the point (a, b).

R_x Remind students that interval notation is used to describe key features of a graph and the interval (a, b) refers to a set of x-values from a to b. To avoid confusion they should refer to the context or wording of the question.

- Students have difficulty distinguishing between the graph of a parabola and the graph of a quartic function.

R_x Discuss with students the difference between the features of graphs ii), iii), and v), in step 1 of the **Investigate**, page 5. Point out that the higher the value of even degree functions the flatter the graph is near the vertex. Have students graph the functions on a graphing calculator and then look at the table values between -1 and 1. Press [2nd] [TBLSET] to access the **TABLE SETUP** and enter 0.1 for Δ**Tbl**.

Mathematical Process Expectations

Process Expectation	Selected Questions
Problem Solving	
Reasoning and Proving	4–6, 8, 9, 12, 13, 15–17
Reflecting	7, 10–13, 15–17
Selecting Tools and Computational Strategies	4–6, 8–13, 15
Connecting	3–13, 15, 17
Representing	4–6, 8–13, 15, 17
Communicating	3, 5, 7, 8, 10–13, 15, 17