5.4 Evaluating Polynomial Functions

Study Guide and Exercise Book Pages
94 to 97

Tools
- graphing calculator
- computer with dynamic geometry software

Related Resources
- T–2 *The Geometer's Sketchpad®* 4
- T5–5 How to Do Section 5.4 Example Using TI-83Plus/ TI-84 Plus and TI-Nspire™ CAS

Teaching Suggestions

Key Concepts

- When evaluating functions graphically, it may be helpful for students to draw a vertical line from the polynomial function to the designated x-value on the x-axis. They can then determine the corresponding y-value by drawing a horizontal line from the point where the vertical line intersects the polynomial function to the y-axis.
- It may be necessary to review the order of operations to help students evaluate functions by substituting a given x-value into the polynomial function.
- Review how to determine x-intercepts and y-intercepts of polynomial functions.

Example

- The **Example** highlights some features on the graphing calculator that are lesser known to students.
- The **Example** helps students to connect a visual to answers they also find algebraically.
- Ask students what other function on the graphing calculator finds the value of y, given the value of x (**TRACE**).

Questions

- To help students' mental math skills, have them complete **question 1** algebraically without a calculator. They should be able do all operations mentally. They can then check their answer with technology.
- After completing **questions 1** to **4**, discuss with students how the skills they are practising help them draw accurate graphs by hand.
- For **question 6**, discuss with students why it might be useful to give functions different names, such as $f(x)$, $g(x)$, and $h(x)$.
- For **question 7**, reactivate students' understanding of the term *y-intercept*. Clarify that for this question, they are to inspect the equation, not its graph.
- For help with **question 8**, suggest that students refer to the **Example**.
- There are several calculator methods and functions that you might want to discuss with students before doing **questions 9** and **10**, including
  - how to determine a reasonable domain, or window, for a question
  - how to use a table of values to determine the correct window
  - how to use the **CALC** function to determine the value of a function for a given x-value
  - how, for **question 9d**), time is the x-coordinate of the intersection point with a graph of $y = 37$
- Remind students to use accurate units when expressing their final answers for **questions 9** and **10**.
- Students may have difficulty visualizing the box in **question 10**. Design the given polynomial function with students. You may even wish to create a three-dimensional model. Discuss with students what a reasonable domain would be for this question.
- For **question 10d**), discuss how technology can help find an accurate answer. Students can enter another equation, $y = 1875$, and find the intersection point.

Common Errors
- Some students may still have trouble understanding and using function notation.

R_x Have students find new ways to describe function notation to each other. For example, "$f(x) =$ means we have an equation for a function with the variable x used on the right-hand side. $f(2)$ means we are replacing each x with the number 2, and then calculating the answer. We are finding the y-value when $x = 2$."

Differentiated Instruction
- Use **cooperative task groups** to complete **questions 9** to **13**.

- In **question 11**, help students to find the volume of a cylinder in terms of the radius.
- **Question 12** will be accessible to all students using technology.
- For **question 14**, remind students that exact answers do not have repeating or non-repeating decimals. These answers may have a root sign or a fraction that cannot be reduced any further. Approximate answers represent repeating or non-repeating decimals that have been rounded.
- For **question 14**, encourage students to evaluate the functions graphically using a graphing calculator. This provides a visual representation, as well as the value of the function, for a particular value of x. As an extension, have students discuss what happens to the graph near $x = \sqrt{3}$ in part **d**).
- For **question 14**, encourage students to recall exponential functions, and to learn more about root functions and rational functions.
- For **question 15a**), some students may have difficulty substituting variables into the polynomial expression and then simplifying it. Help students recall how to expand and simplify powers of binomial expressions. Most students will remember the acronym FOIL, but will need practice using it.

Technology Suggestions

- See **T5–5 How to Do Section 5.4 Example Using TI-83Plus/TI-84 Plus and TI-Nspire™ CAS** for a detailed solution for the **Example**.
- In the **Example**, you can graph the function using *The Geometer's Sketchpad*®, and create a table of values using the **TABULATE** feature under the **Graph** menu. This will generate a table of values dynamically as you drag a point along the function.
- For **questions 1** to **4**, students can define a function using TI-Nspire™ CAS. Then, they can easily evaluate the function for any desired value. They can also quickly create a table of values using a **Lists & Spreadsheets** page.
- Consider showing a dynamic solution for at least one of the parts of **questions 8** to **10** using *The Geometer's Sketchpad*®. Plot a point on the function, measure its coordinates, and then drag the point along the function to display the changes in measurements dynamically.
- For **question 13**, encourage students to use *The Geometer's Sketchpad*® to show graphically that the three lines intersect at one point.
- Suggest that students define the function in **question 15** using a CAS. Then, they can enter parts **b**) to **d**) and use the CAS to evaluate the function.

Mathematical Process Expectations

The table shows questions that provide good opportunities for students to use the mathematical processes.

Process Expectation	Selected Questions
Problem Solving	9–13
Reasoning and Proving	n/a
Reflecting	9–11
Selecting Tools and Computational Strategies	12, 14
Connecting	7, 11, 14, 15
Representing	10–12, 14
Communicating	7, 13

Ongoing Assessment

- **Question 9** can be used as an indicator of student understanding for this section.