From Graphs To Functions

TIMATH.COM: PRECALCULUS

TEACHER NOTES

Math Objectives

Students will be able to:

- Write an equation for a polynomial function when given the graph of a function with the same zeros of the same type.

Vocabulary

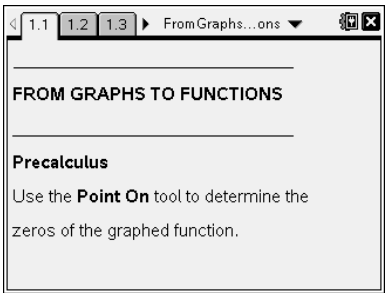
- degree of a polynomial
- end behavior
- multiple zeros
- multiplicity

About the Lesson

- This lesson is a follow-up lesson to the Precalculus activity *Multiplicity of Zeros of Functions*.
- Students will utilize graphs of polynomial functions to determine the zeros of the functions and whether the functions cross the *x*-axis at these zeros or just touch the *x*-axis at the zeros.
- Given the graphs of three functions, students will write possible functions with the same number and type of zeros in the graph.
- Prerequisite knowledge: zeros and end behavior of a function.

Related Lessons

- Prior to this lesson: Multiplicity of Zeros of Functions
- After this lesson: You Can't Get There From Here



TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Click slider arrows to change values

Tech Tips:

- Make sure the font size on your TI-Nspire handhelds is set to Medium.
- You can hide the function entry line by pressing ctrl G.

Lesson Materials:

Student Activity

- FromGraphsToFunctions.pdf
- FromGraphsToFunctions.doc

TI-Nspire document

- FromGraphsToFunctions.tns

Visit www.mathnspired.com for lesson updates and tech tip videos. (optional)

Discussion Points and Possible Answers

Tech Tip: Press esc *to hide the entry line if students accidentally click the chevron.*

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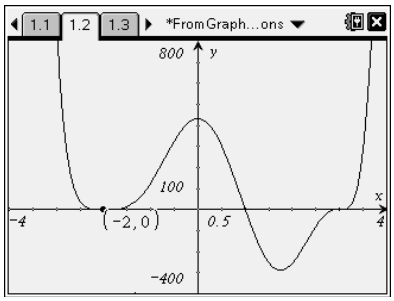

1. What are the zeros of the function?

   Answer: $x = -2$, $x = 1$, $x = 3$

   Tech Tip: To find the zeros, students can use the **Point On** tool to place a point on the graph. Either drag the point along the graph until the word zero appears or change the *y*-coordinate to 0. The value of the *x*-coordinate is the value of the zero. (Students should NOT use the **Graph Trace** tool.)

2. For what value(s) of *x* does the graph of the function cross the *x*-axis? If you wrote this type of zero as a factored term in a polynomial function, what type of exponent would it have?

   Answer: $x = 1$, $x = 3$; The term would have an odd exponent.

3. For what value(s) of *x* does the graph of the function touch but not cross the *x*-axis? If you wrote this type of zero as a factored term in a polynomial function, what type of exponent would it have?

   Answer: $x = -2$; The term would have an even exponent.

4. Write the factored form of a function with the *smallest* degree that has the same zeros as the graph.

   Answer: $f(x) = (x + 2)^2(x - 1)(x - 3)$

   Teacher Tip: This is only one possible equation with the given zeros, but it isn't the exact equation of the given graph. Remind students that the question asks for the equation with the smallest degree.

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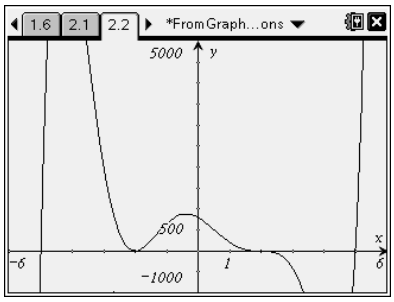

5. What are the zeros of the function?

   Answer: $x = -5$, $x = -2$, $x = 2$, $x = 5$

6. For what value(s) of x does the graph of the function cross the x-axis?

   Answer: $x = -5$, $x = 2$, $x = 5$

7. For what value(s) of x does the graph of the function touch but not cross the x-axis?

   Answer: $x = -2$

8. If the function of the graph has a degree of 9, what is a possible function in factored form? Explain the method you used to determine the function.

   Sample Answer: $f(x) = (x + 5)^3(x - 5)^3(x - 2)(x + 2)^2$; I wrote the factored form of the function with the smallest degree and then increased the exponents by 2 until I reached a degree of 9.

Wrap Up:

The TI-Nspire document includes a third function for extra practice. You may want to delete Problem 3 from the student file and use this to assess understanding at a later time.

Upon completion of the discussion, the teacher should ensure that students understand:
- How to write an equation for a polynomial function with given zeros.

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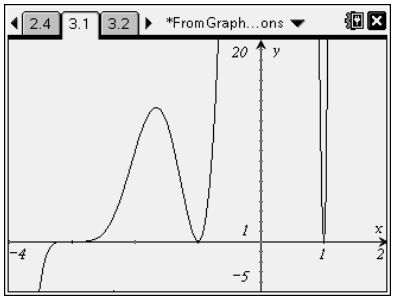

Problem 3 in the TI-Nspire document provides an additional opportunity for investigation or for assessment of student understanding. Comments on this additional problem are provided below.

9. Write the factored form of the equation with the *smallest* degree that would have the same zeros of the same type as the zeros visible in the graph.

   Answer: $f(x) = (x + 3)(x + 1)^2(x - 1)^2$

10. Describe how you could verify whether the equation you wrote matches the graph. What other information would be helpful in finding the exact equation?

   Sample Answers:

   (1) Graph the factored form of the possible function with the given graph and see if they match.

   (2) Expand the function to standard form and match the function to the function in the function entry line.

   (3) Substitute points into the function and check if the points match the graph.

   Helpful information would be the degree of the polynomial or the multiplicity of each zero.