One of the Many Ways

ID: 11884

Time required
50–60 minutes

Activity Overview

In this activity, students will graph polynomials to determine the value and number of zeros for a given polynomial. Students will also use the Rational Root Theorem to determine the value of zeros for a polynomial and connect the number of zeros to the degree of the polynomial.

Topic: Polynomials

- *Zeros & Roots*
- *Rational Root Theorem*

Teacher Preparation and Notes

- *This activity has two parts. The teacher can use either part independently or both parts of the activity. Both parts of the activity ask similar questions about finding zeros and relating the number of zeros to the degree of the polynomial.*
- *Students may want or need to change the window to see the graphs. Students can change the window by pressing @ and enter appropriate settings for the window.*
- ***To download the student worksheet, go to education.ti.com/exchange and enter "11884" in the keyword search box.***

Associated Materials

- *OneOfTheManyWays_Student.doc*

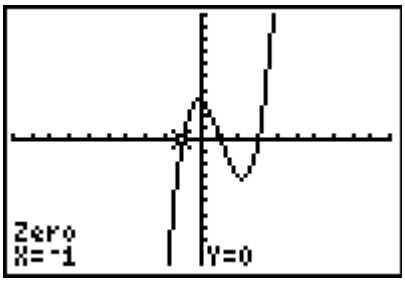
Suggested Related Activities

To download any activity listed, go to education.ti.com/exchange and enter the number in the keyword search box.

- *Discriminating Against the Zero (TI-84 Plus family) — 11520*
- *Asymptotes and Zeros (TI-84 Plus family) — 9301*
- *Watch Your P's and Q's (TI-84 Plus family) — 8975*

Problem 1 – Finding Zeros Graphically

Students will graph polynomial functions and use the **zero** command from the CALCULATE menu to find the values of the zeros. This process will display the coordinates of the points. Students will need to understand that the first number of the coordinate is the value of the zero. Explain to them that all real zeros are also *x*-intercepts.



Students are asked to observe the number of zeros compared to the degree of the polynomial. They should notice that the number of zeros is less than or equal to the degree of the polynomial.

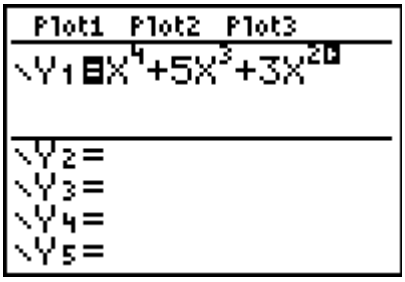
Discussion Questions

- How does one know by plugging in a number into the equation that it is a zero?
- For any polynomial, how many zeros are there and what is the degree of the polynomial?
- Why (or when) are there less zeros than the degree of the polynomial?
- What is common about where the number of zeros is less than the degree of the polynomial?

If using Mathprint™ OS:

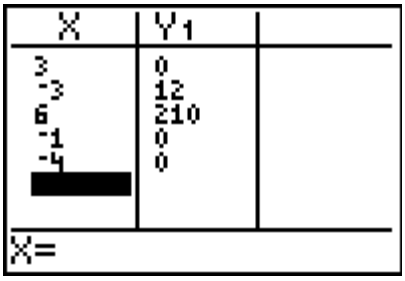
When entering the function in Y1 and students press ^, the cursor will move to the exponent position.

Students should enter the value of the exponent and then press ▶ to move out of the exponent position.



Problem 2 – Rational Root Theorem

In this part of the activity, students will use the Rational Root Theorem to find and test possible zeros of the graphed polynomial. If students know polynomial or synthetic division, they can use a more direct method for finding zeros. Students should notice the relationship between the number of zeros and degree of polynomial.



Discussion Questions

- For any polynomial, how many roots are there and what is the degree of the polynomial?
- Why (or when) are there less zeros than the degree of the polynomial?
- Is there a particular feature of the graph of a polynomial with less roots than the degree?
- Did anyone find a way to determine the zeros faster than just plugging in values?

Solutions – student worksheet
Problem 1:

Function	Zeros
$f(x) = x^3 - 3x^2 - x + 3$	**1, –1, 3**
$f(x) = x^3 - 3x - 2$	**–1, 2**
$f(x) = x^4 + 5x^3 + 3x^2 - 5x - 4$	**–4, –1, 1**
$f(x) = x^4 - x^3 - 7x^2 + x + 6$	**–2, –1, 1, 3**
$f(x) = x^4 - 3x^3 - 6x^2 + 28x - 24$	**–3, 2**
$f(x) = x^5 + 2.6x^4 - 1.11x^3 - 3.74x^2 - 0.73x + 0.3$	**–2.5, –1, –0.5, 0.2, 1.2**

1. Sample Answer: **The number of roots is less than or equal to the degree, *n*, of the polynomial.**
2. **Sometimes**
3. **False**
4. **5**
5. **Two**
6. ***x* = –3** and ***x* = 2**

Problem 2:

Function	Possible Zeros	Rational Zeros
$f(x) = x^3 + 2x^2 - 11x - 12$	**±1, 2, 3, 4, 6, 12**	**–4, –1, 3**
$f(x) = x^4 + 4x^3 - 6x^2 - 36x - 27$	**±1, 3, 9, 27**	**–3, –1, 3**
$f(x) = 10x^4 - 3x^3 - 29x^2 + 5x + 12$	**±1, 2, 3, 4, 6, 12,** $\frac{1}{2}, \frac{3}{2}, \frac{1}{5}, \frac{2}{5}, \frac{3}{5}, \frac{4}{5}, \frac{6}{5}, \frac{12}{5}, \frac{1}{10}, \frac{3}{10}$**,**	$-\frac{3}{2}, \frac{4}{5}$
$f(x) = x^4 - 2x^3 - x^2 - 2x - 2$	**±1, 2**	**No Rational Zeros**