**Algebra 3-4**

**Unit 5: Polynomial Functions**

Designer(s): OPS Secondary Math Department Grade Level: Algebra 3-4, 2013

Polynomial Functions

Polynomial functions are used to model all kinds of real-world situations, like the energy produced by a turbine.

In this chapter, you will also learn theorems that will help you when working with polynomial functions and equations.

Unit Overview

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| **Unit 5: Polynomial Functions** | | |
| **Essential Questions** | **Standard** | **Objectives**  F= Factual C=Conceptual D=Debatable |
| 1. What does the degree of a polynomial tell you about its related polynomial function? | MA 12.3.1.e  MA 12.3.2.d | * Students will write a polynomial function given a polynomial equation. (C) * Students will identify the degree of a polynomial equation. (F) * Students will identify the highest power of polynomial function. (F) |
| 1. For a polynomial function, how are factors, zeros, and x-intercepts related? | MA 12.3.1.e | * Students will write a polynomial given its factors or zeros. (C) * Students will identify the zeros of a polynomial function by finding the x-intercepts of its graph. (C) |
| 1. For a polynomial equation, how are factors and roots related? | MA 12.3.1.e | * Students will factor a polynomial equation. (C) * Students will apply the Zero-Product Property. (C) |

**Unit 5: Polynomial Functions**

**Critical Content and Skills:**

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| *Knowledge Statements*  Students will know…   1. **Vocabulary**: Polynomial, Standard Form, Leading Coefficient, Constant Term, Degree, *y*-intercept, Domain, Range, End Behavior, *x*-intercept, Solutions, Roots, Zeros. 2. **Theorems:** Conjugate Root Theorem, Rational Root Theorem, Fundamental Theorem of Algebra. 3. **Tools to Solve:** Quadratic Formula, Synthetic Division, Factoring (Common monomials, Trinomials, Factor by grouping, Difference of squares, Sum or difference of cubes), Completing the Square. 4. **Graphing:** General shapes of polynomials (Constant, Linear, Quadratic, Cubic, Quartic, Quintic, and Higher Degree). | *Key Skill Statements*  Students will know how to…   1. Find the characteristics of a polynomial.   Standard Form  Degree  Leading Coefficient  Constant Term  Number of Roots  Maximum Number of Turns  *y*-intercept  End Behavior  Possible Rational Zeros   1. Solve polynomials of degree greater than or equal to 3 using various methods.   Factoring  Sum/Difference of Cubes  Quadratic Formula  Remainder/Factor Theorem and Synthetic Division   1. Sketch polynomials using its characteristics and roots.      1. Write the equation of a polynomial given its roots. |

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| **Algebra 3-4**  **Unit 5: Polynomial Functions** | | | |
| **Advanced**  **Score 4.0** | In addition to the Proficient (3.0) performance, makes ***indepth*** inferences and extended applications of what was learned, including connections to other experiences. | | • Apply knowledge of polynomial functions in real life applications.   * Make inferences about a polynomial given characteristics. |
|  | **Proficient +**  **Score 3.5** | In addition to the complex ideas and processes (Proficient 3.0) performance, ***partial success*** at in-depth inferences and extended applications of what was learned, including connections to other experiences. | |
| **Proficient**  **Score 3.0** | ***No major*** errors or omissions regarding any of the information and simple (Basic, 2.0) or complex processes (Proficient, 3.0) that was explicitly taught. | | • Relate the actual number of turns back to the number of real zeros.  • State the possible real vs. complex solutions for any given polynomial.  • Find the solutions of a polynomial degree 3 or higher.  • Sketch the graph of any given polynomial function. |
|  | **Basic +**  **Score 2.5** | ***No major*** errors or omissions regarding any of the information and/or simpler details and processes (Basic, 2.0) and ***partial*** knowledge of the more complex ideas and processes (Proficient, 3.0) | |
| **Basic**  **Score 2.0** | ***No major*** errors or omissions regarding the simpler details and processes (Basic, 2.0), but ***major*** errors or omissions regarding the more complex ideas and processes (Proficient, 3.0). | | • Identify the standard form, degree, leading coefficient, constant term, number of roots, and y-intercept of a polynomial.  • Identify missing roots using the conjugate root theorem.  • List the possible rational solutions using the Rational Root Theorem.   * Identify end behavior.   • Divide polynomials using long and/or synthetic division. Write the polynomial function of least degree with leading coefficient of 1 given the solutions. |
| **Below Basic**  **Score 1.0** | A ***partial*** understanding of ***some*** of the simpler details and processes (Basic, 2.0), but ***major*** errors or omissions regarding the more complex ideas and processes. | | |
| **Failing**  **Score 0** | ***No*** evidence or ***insufficient*** evidence of student learning. | | |

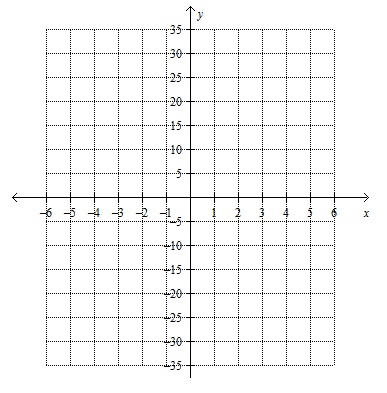
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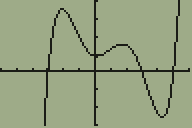
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**Unit 5 Polynomial Functions Assessment**

Write answers in the blanks provided. Show all necessary work.

1. Divide: ) ÷ . **[L2]**

1. Is a factor of ? If it is, write as a product of two factors. **[L2]**
2. 1. Degree: \_\_\_\_\_ **[L2]**
   2. Leading Coefficient: \_\_\_\_\_ **[L2]**
   3. Total Number of Solutions: \_\_\_\_\_ **[L2]**
   4. Y-Intercept: \_\_\_\_\_ **[L2]**
   5. List of Possible Rational Solutions: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **[L2]**
   6. Right End Behavior: \_\_\_\_\_\_\_\_ **[L2]**
   7. Left End Behavior: \_\_\_\_\_\_\_\_ **[L2]**
   8. Use an appropriate method to find the solutions to the polynomial (Show your work). **[L3]**
   9. Sketch the graph of the polynomial. **[L3]**
3. A polynomial equation with rational coefficients has the roots . Find two additional roots. **[L2]**

1. Write in standard form a cubic polynomial function with leading coefficient of 1 with zeros . **[L2]**
2. What are the zeros of the function ? What are their multiplicities? **[L3]**
3. Consider the function . A graph has been provided for you.
4.  What is the total number of solutions? **[L2]**
5. Find all zeros. **[L3]**
6. 1. Degree: \_\_\_\_\_ **[L2]**
   2. Leading Coefficient: \_\_\_\_\_ **[L2]**
   3. Total Number of Solutions: \_\_\_\_\_ **[L2]**
   4. List of Possible Rational Solutions: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **[L2]**
   5. Use an appropriate method to find the solutions to the polynomial (Show your work). **[L3]**

1. The city of Mathematica wants to build a road along the town river. The river’s twists can be modeled by ..The road will go directly along the *x*-axis. How many bridges would the city have to build and why? Explain your answer. [**L4**]
2. Determine the value of k so that the divisor is a factor of the dividend. [**L4**]

Unit 5 Polynomial Functions Assessment Mathematician: ANSWER KEY

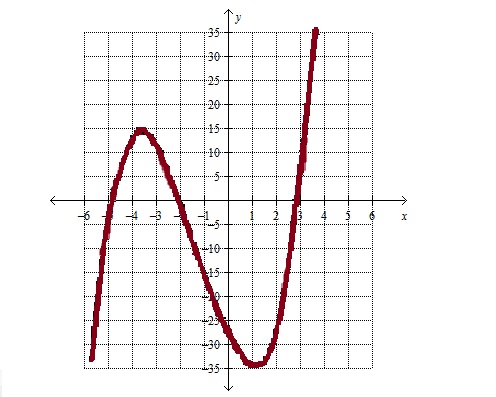
Algebra 3-4

1. Divide: ) ÷ . **[L2]**

or

1. Is a factor of ? If it is, write as a product of two factors. **[L2]**

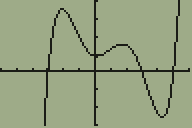
Yes.

1. Degree: 3 **[L2]**
2. Leading Coefficient: 1 **[L2]**
3. Total Number of Solutions: 3 **[L2]**
4. Y-Intercept: –30 **[L2]**
5. List of Possible Rational Solutions: ±1 , ±2 , ±3 , ±5, ±6, ±10, ±15, ±30 **[L2]**
6. Right End Behavior: Rise **[L2]**
7. Left End Behavior: Fall **[L2]**
8. Use an appropriate method to find the solutions to the polynomial (Show your work). **[L3]**
9. Sketch the graph of the polynomial. **[L3]**
10. A polynomial equation with rational coefficients has the roots . Find two additional roots. **[L2]**

1. Write in standard form a cubic polynomial function with leading coefficient of 1 with zeros . **[L2]**
2. What are the zeros of the function ? What are their multiplicities? **[L3]**

0 with multiplicity 2;

1 and 3 with multiplicity 1

1. Consider the function . A graph has been provided for you.
2.  What is the total number of solutions? **[L2]**

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1. Find all zeros. **[L3]**
2. 1. Degree: 4 **[L2]**
   2. Leading Coefficient: 2 **[L2]**
   3. Constant: 4
   4. Total Number of Solutions: 4 **[L2]**
   5. List of Possible Rational Solutions: ±1 , ±2 , ±4,  **[L2]**
   6. Use an appropriate method to find the solutions to the polynomial (Show your work). **[L3]**
3. The city of Mathematica wants to build a road along the town river. The river’s twists can be modeled by ..The road will go directly along the *x*-axis. How many bridges would the city have to build and why? Explain your answer. [**L4**]

Answers may vary.

*Possible Answers:*

*3 Bridges. The solutions are x = -2, 0, 2. The river crosses the road (x-axis) 3 times.*

*1 Bridge. The city could build one long bridge to pass over the three places where the river crosses the road.*

1. Determine the value of k so that the divisor is a factor of the dividend. [**L4**]

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| **Learning Experiences** | **Text Pages/Resources** |
| **Vocabulary**   * Word wall * Foldable – See Glencoe @2010 Foldables by Dinah Zike for more information * Matching the word to the definition, graph, or example * Anticipation guide (pre and post) |  |
| * **Lessons Resources at the end of each section.** * **Online resources at pearsonsuccessnet.com** | Pearson Algebra 2  5.1  5.2  5.3  5.4  5.5  5.6 |
| **General:**  **Test-Taking Strategy**  Be sure to check the reasonableness of your answer. If students are asked for the balance of a bank account where you were dealing with amounts in the hundreds, it is not reasonable to give an answer in the millions. To make sure the answer to a problem is reasonable, you can estimate before you calculate. If the answer is close to your estimate, your answer is probably correct. |  |

**Teacher Notes/Additional Resources**

**General Algebra & Math sites:**

* AlgebraLAB: Making Math & Science Connections [www.algebralab.org](http://www.algebralab.org)
* Classzone from Holt McDougall’s free site includes really cool animations. You and your students will simply need to figure out which chapter in their book relates to what we’re studying. <http://www.classzone.com/cz/books/algebra_1_2011_na/book_home.htm?state=NE>
* Kuta software <http://www.kutasoftware.com> Excellent free worksheets (with answers) <http://www.kutasoftware.com/free.html>
* NCTM’s Figure This! Web site has several challenge problems that are designed for families to do together. <http://figurethis.org/download.htm> These challenges (there are 80 of them!) could be used for daily warm-ups in class (several involve estimation), weekly Problem-of-the-Week, and even a challenge problem along with their homework, if relevant.
* Math is Fun! Includes an illustrated math dictionary and helpful tutorials for students. [www.mathisfun.com](http://www.mathisfun.com)
* Daily Math Review <http://www.aea11.k12.ia.us/E2T2/dmr.html>
* Great online timer: <http://www.online-stopwatch.com>
* Porta Portal’s consolidated resource list <http://guest.portaportal.com/mrburke>
* Algebra2Go <http://www.saddleback.edu/faculty/lperez/algebra2go/index.html>
* About.com Education site has great warm ups <http://712educators.about.com/cs/warmups/l/blwarmmath.htm>
* Southern Regional Education Boards Instructional Resources <http://www.evalutech.sreb.org/InstResources/index.asp>

**Books:**

* Various resources provided by publishers for the book selection process

**Videos:**

* BrainPop [www.brainpop.com](http://www.brainpop.com)
* Teacher Tube [www.teachertube.com](http://www.teachertube.com)