Objectives

Students will be able to:
• Relate the real roots of a polynomial to the x-intercepts of its graph.
• Graph simple polynomials of degree three and higher.
• Determine possible equations for polynomials of higher degree from their graphs.

Warm-Up

Ask students to sketch graphs of the functions $y = (x - 2)(x + 2)$, $y = (x - 2)^2$, and $y = (x - 2)^3$. Check the graphs with W|A.
Lesson

- Point out to students that each binomial factor of a polynomial generates a root and that each of these roots is equal to an \( x \)-intercept of the graph of the polynomial. Ask them to predict the \( x \)-intercepts of the equation \( y = x^2(x - 5)(x + 5) \) and to check their answers with W|A.
• Explain that the degree of a polynomial and the sign of its leading coefficient affect the general behavior of its graph at increasingly large absolute values of $x$. Illustrate the reflectional and rotational symmetries of even and odd functions respectively with several W|A examples.

• Point out to students that wherever the absolute value of $x$ is large, the numbers in the binomials become insignificant and the polynomial can be approximated by the leading term $a x^n$. For example, $(x + 3)(x - 1)^3(x - 10)$ becomes close to $x^5$ at large absolute values of $x$. 
Math: Algebra II Graphing Polynomials of Higher Degree

\[ y = (x+3)(x-1)^3(x-10) \]

Alternate forms:
\[ y = x^5 - 10x^4 - 6x^3 + 68x^2 - 83x + 30 \]
\[ y = x^5 - 7x(x-1)^3 - 30(x-1)^3 \]

\[ y = x^5 \]

\[ (x+3)(x-1)^3(x-10), x^5 \text{ from } -100 \text{ to } 100 \]
• Explain to students that the degree of a binomial factor in a polynomial determines the behavior of its graph at the \textit{x}-intercept associated with that binomial factor. Return to the first example, \( y = x^2(x - 5)(x + 5) \), and use \texttt{W|A} to illustrate the effects of raising a binomial factor to successively higher powers.
Closing

Use W|A to create a graph of the equation \( y = x(x + 10)(x + 5)(x - 5)^2(x - 10) \) and ask students to derive a possible equation for the polynomial based on the graph and what students have learned during class.

![Graph of the equation](image)

Demonstrations

- Polynomial Roots
- End Behavior of Polynomial Functions
- Local Behavior of a Polynomial Near a Root
- Where Are My Roots?
- Parameters for Plotting a Cubic Polynomial
- Polynomial Graph Generator