Date ____________________

Dear Family,

In Chapter 6, your child will operate (add, subtract, multiply, and divide) with polynomials and apply several theorems about polynomial functions.

A **monomial** is a product of numbers and variables with whole number exponents. A **polynomial** is a single monomial or a sum or difference of several monomials. Each monomial in a polynomial is called a *term*. Polynomials are described by the number of terms that they have.

Classifying Polynomials by Terms		
Name	**Terms**	**Example**
Monomial	One term	$3x^5$
Binomial	Two terms	$-2x^3 + 6$
Trinomial	Three terms	$2x^2 + x - 5$

Polynomials are also described by their *degree*. The **degree of a monomial** is the sum of the exponents of the variables. The **degree of a polynomial** is the degree of the term with the greatest degree. When the terms are in descending degree, the polynomial is said to be in *standard form*, and the coefficient of the first term is called the **leading coefficient**.

Classifying Polynomials by Degree		
Name	**Degree**	**Example**
Constant	0	6
Linear	1	$x + 6$
Quadratic	2	$4x^2 + x + 6$
Cubic	3	$-2x^3 + 6$
Quartic	4	x^4
Quintic	5	$3x^5 + x - 1$

Standard Form: $2x^3y - 4x + 1$

degree of terms: 4 1 0

degree of polynomial: 4

The variable y can be thought of as y^1. So, $2x^3y^1$ has degree $3 + 1 = 4$.

Because this polynomial has degree 4 and 3 terms, you can say it is a "quartic trinomial."

To add or subtract polynomials, you combine like terms.

Add $(x^2 + 5) + (3x^2 - 2x - 8)$.

$(x^2 + 3x^2) + (-2x) + [5 + (-8)]$ *Combine like terms.*

$4x^2 \quad -2x \quad -3$ *Simplify.*

To multiply two polynomials, you distribute each term of the first polynomial to each term of the second polynomial.

Multiply $(x + 2)(x^2 + 4x - 3)$.

$x(x^2) + x(4x) + x(-3) + 2(x^2) + 2(4x) + 2(-3)$ *Distribute terms.*

$x^3 \quad +4x^2 \quad -3x \quad +2x^2 \quad +8x \quad -6$ *Multiply.*

$x^3 + 6x^2 + 5x - 6$ *Combine like terms.*

You can divide polynomials using long division. However, if the divisor is a linear binomial with leading coefficient 1, you can use a shorthand method called **synthetic division**.

Divide $(2x^2 + 7x + 9) \div (x + 2)$.

$$\begin{array}{r|rrr} -2 & 2 & 7 & 9 \\ & & -4 & -6 \\ \hline & 2 & 3 & \boxed{3} \end{array}$$

$$2x + 3 + \frac{3}{x + 2}$$

Step 1: Think of the divisor as $(x - a)$ and put the value of a in the upper left corner. Then write the coefficients of the dividend.

Step 2: In the first column, add down. Multiply the sum by a and put the product in the next column. Repeat, working left to right.

Step 3: Read the quotient from the bottom line. The last number is the remainder.

A polynomial function is a function whose rule is a polynomial.

Polynomial Function: $P(x) = x^3 + 3x^2 + 4$

Your child will learn several important theorems about polynomial functions. These theorems will be used individually and collectively to factor polynomial expressions, to find roots (or solutions) of polynomial equations, and to find zeros (x-intercepts) of polynomial functions.

Remainder Theorem	If the polynomial function $P(x)$ is divided by $(x - a)$, then the remainder r is the same as evaluating $P(a)$.
Factor Theorem	For any polynomial function $P(x)$, $(x - a)$ is a factor of $P(x)$ if and only if $P(a) = 0$.
Rational Root Theorem	If the polynomial $P(x)$ has integer coefficients, then every rational root of the equation $P(x) = 0$ can be written in the form $\frac{p}{q}$, where p is a factor of the constant term and q is a factor of the leading coefficient.
Irrational Root Theorem	If the polynomial $P(x)$ has rational coefficients and $a + b\sqrt{c}$ is a root of the equation $P(x) = 0$, where a and b are rational and $\sqrt{c}$ is irrational, then $a - b\sqrt{c}$ is also a root of $P(x) = 0$.
Complex Conjugate Root Theorem	If $a + bi$ is a root of a polynomial equation with real-number coefficients, then $a - bi$ is also a root.
Fundamental Theorem of Algebra	Every polynomial function of degree $n \geq 1$ has exactly n complex zeros, including multiplicities.

The chapter concludes with an exploration of the graphs of polynomial functions. Special features such as shape, **end behavior**, **local maxima** and **local minima**, and transformations are examined and applied.

For additional resources, visit go.hrw.com and enter the keyword MB7 Parent.