PreCalculus Name: Period: Date:

10/16

Lesson 3-2: Dividing Polynomials

Objective

Students will…

- Be able to use long division and synthetic division to divide a polynomial.
- Be able to identify the dividend, divisor, quotient, and the remainder after dividing a polynomial using long division.
- Be able to know and use the Remainder and Factor Theorem.

End Behavior

Polynomials can also be studied extensively using algebra. From our experience with graphing, we realized that factoring is a powerful tool when it comes to studying polynomials. Recall that factoring really is _______________. Hence, to factor, we must learn how to divide polynomials. Dividing polynomials is much like dividing numbers.

Ex. $\frac{38}{7} = 5 + \frac{3}{7}$

When we divide 38 by 7, we end up with a ____________________ of 5 and the __________________________ of $\frac{3}{7}$

Long Division

Much like how we first learned how to divide numbers, we can use long division to divide polynomials.

Example: Divide $6x^2 - 26x + 12$ by $x - 4$.

So, we are done when the long division ends with a polynomial that is of _______________degree than what we divided by. In our case, we divided by $x - 4$ (degree 1) and ended up with 4 (degree 0). So, we can interpret our result in two ways:

$\frac{6x^2-26x+12}{x-4} =$ Or $6x^2 - 26x + 12 =$

Example

For the following, find the quotient and remainder using long division.

1. $\frac{x^2-6x-8}{x-4}$
2. $\frac{x^3+3x^2+4x+3}{3x+6}$
3. $\frac{2x^5-7x^4-13}{4x^2-6x+8}$

Synthetic Division

Although long division will always get the job done with dividing polynomials, ______________________ division is a quicker method. The only drawback to synthetic division is that it can only be used when the divisor is of the form . Here are few things to keep in mind when using synthetic division:

- We only need to use the ________________________ of each term.
- Need to make sure to include "____" in places where a degree term is missing. For example, for polynomial $x^3 + x - 7$, the coefficient we use would be 1, 0, 1, -7 (0 for the degree 2 term).
- For our divisor $x - c$ the constant we use as our divisor is $-c$. For example, for divisor $x - 8$, the constant we use would be $-(-8) = 8$.

Example

Divide $2x^3 - 7x^2 + 5$ by $x - 3$ using synthetic division.

Use synthetic division to divide $\mathrm{P(x)} = 5x^3 - 2x^2 + x - 10$ by $x - 3$

Remainder Theorem

Synthetic division is useful because it can sometimes cut time on evaluating polynomials.

The Remainder Theorem- If polynomial $P(x)$ divided by $x - c$, then the remainder is the value of ______.
So, applying to our previous example, we know that 110 (the remainder) is the value of $P(3)$.

Example

Let $P(x) = 3x^5 + 5x^4 - 4x^3 + 7x + 3$. Divide by $x + 2$ using synthetic division. Then, use the remainder theorem to evaluate $P(-2)$.

Factor Theorem

The last theorem to observe in this section is ______________________Theorem, which says that zeros of polynomials correspond to factors.

The Factor Theorem- *c* is a zero of *P* if and only if   is a factor of $P(x)$.
So, if a certain *c* is a zero of any polynomial, performing either long division or synthetic division by the divisor $x - c$ should yield _____ remainder (or remainder 0).

Example

Use the Factor Theorem to show that $x - c$ is a factor of
$P(x) = x^3 - 3x^2 + 3x - 1$, $c = 1$ and factor completely to find all the zeros.

Homework 10/16
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