Module 2 Lesson #4:

Multiplying and Dividing Polynomials

Remainder Theorem

& Factor Theorem



SWUT:

Polynomials can be divided using a process similar to long-division of whole numbers.

You can divide polynomial $P(x)$ by polynomial $D(x)$ to get a polynomial quotient $Q(x)$ and a polynomial remainder$ R(x)$, such that$ P(x)=D(x)Q(x) + R(x)$.

If $R(x) = 0,$ then $D(x)$ and $Q(x)$ are factors of$ P(X)$.

Synthetic division simplifies the long division process for dividing by a liner expression $(x-a).$

The Remainder Theorem states: If you divide a polynomial $P(x)$ of degree $n\geq 1$ by$ (x-a)$, the remainder is$ P(a)$.

The Factor Theorem states: If $P\left(a\right)=0$ then $(x-a)$ is a factor of $P(x)$ and a is a root (zero).

**TABULAR METHOD**

Use tabular method to multiply $(x+8)(x+7)$ and combine like terms.

(ALWAYS START \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)



Exercises 1–2

1. Use the tabular method to multiply $(x^{2}+3x+1)(x^{2}-5x+2)$ and combine like terms.
2. Use the tabular method to multiply $(x^{2}+3x+1)(x^{2}-2)$ and combine like terms.

\*\*\*MUST FILL IN \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\*\*\*

**Division by…Multiplication???**

Multiply these polynomials

$$\left(2x+5\right)\left(x^{2}+5x+1\right)$$

Knowing that result, answer the following questions.

Divide

$\frac{\left(2x^{3}+15x^{2}+27x+5\right)}{\left(2x+5\right)}$

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$\frac{\left(2x^{3}+15x^{2}+27x+5\right)}{\left(x^{2}+5x+1\right)}$

But how can we divide polynomials if we didn’t have the factors to start with?

**Intro to Reverse Tabular (multiplying back)**

The process….

1. $\frac{x^{2}+6x+9}{x+3}$
2. $\left(x^{3}-27\right)÷\left(x-3\right)$
3. $\left(7x^{3}-8x^{2}-13x+2\right)÷\left(7x-1\right)$
4. $\frac{x^{6}+4x^{4}-4x-1}{x^{3}-1}$

What happens when there is a remainder?

x + 5 ) 4x2 + 23x - 16

 So, when we divide two polynomials, we get another polynomial and usually a remainder. This is known as writing the rational expression in quotient-remainder form. $Q\left(x\right)+\frac{R(x)}{(x-a)}$

Try these:

1. $\frac{x^{2}+6x-5}{x-3}$
2. $\frac{x^{3}+2x^{2}+41}{x+5}$

Remainder Theorem:

Find the remainders of these division problems

1. $\frac{x^{2}-6x+11}{x-4}$
2. $\frac{3x^{3}+17x+25}{x-2}$

What if the remainder is zero?

Now, using the remainder theorem, we can check if an expression is a factor of a polynomial.

1. Is $(x+3)$ a factor of$ (x^{4} – 10x^{2} + 9)$? Why or why not?
2. Is $(x – 2)$ a factor of $(2x^{4}-x^{3}-18x^{2}+9x)$? Justify your answer.

**Using Synthetic Division**  \*\*\*divisor ***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

1. $(x^{3}+5x^{2}+7x+3)÷(x+3)$ PROCESS:
2. $\left(x^{3}-5x^{2}-4x+20\right)÷\left(x-5\right)$
3. $(x^{4}-2x^{3}+x^{2}+x-1)÷(x-1)$
4. $(x^{4}-6x^{2}-27)÷(x+2)$