Math 3

4.2 Dividing Polynomials

Unit 4

SWBAT divide polynomials using long and synthetic division.

There are two methods to use when dividing polynomials. The first is ***long division.*** Recall long division of integers and apply the same principals when dividing polynomials!

Integer Long Division:

$1234 \div 7$

$$\begin{array}{r} 176 \\ 7\overline{)1234} \\ -7 \\ \hline 53 \\ -49 \\ \hline 44 \\ -42 \\ \hline 2 \end{array}$$

$176\ 2/7$

Polynomial Long Division:

$(3x^3-2x+5)\div(x-2)$

$$\begin{array}{r} 3x^2+6x+10 \\ x-2\overline{)3x^3+0x^2-2x+5} \\ -3x^3+6x^2 \\ \hline 6x^2-2x \\ -6x^2+12x \\ \hline 10x+5 \\ -10x+20 \\ \hline 25 \end{array}$$

$3x^2+6x+10+\frac{25}{x-2}$

Note: You can use polynomial long division to divide a polynomial of ***any*** degree.

Example 1: Divide $(6x^3+5x^2+x-3)\div(2x-3)$

$$\begin{array}{r} 3x^2+7x+11 \\ 2x-3\overline{)6x^3+5x^2+1x-3} \\ -6x^3+9x^2 \\ \hline 14x^2+1x \\ -14x^2+21x \\ \hline 22x-3 \\ -22x+33 \\ \hline 30 \end{array}$$

$3x^2+7x+11+\frac{30}{2x-3}$

You Try! Divide $(3x^4+9x^2+8x+4)\div(x^2+2)$

$$\begin{array}{r} 3x^2+3 \\ x^2+0x+2\overline{)3x^4+0x^3+9x^2+8x+4} \\ -3x^4+0x^3-6x^2 \\ \hline 3x^2+8x+4 \\ -3x^2+0x-6 \\ \hline 8x-2 \end{array}$$

$3x^2+3+\frac{8x-2}{x^2+2}$

The second method of dividing polynomials is called ***synthetic division.*** Synthetic Division can only be used when the divisor is linear with a leading coefficient of 1.

SYNTHETIC DIVISION

EXAMPLE:

Divide:
$x^3 - 2x^2 - 8x - 35$
by $(x - 5)$.

ZERO IS 5

GRAB THE COEFFICIENTS
$x^3 - 2x^2 - 8x - 35$

5	1	-2	-8	-35
		ADD 5	ADD 15	ADD 35
MULTIPLY	1	3	7	0 ✓
	×5	×5	×5	

MULTIPLY ADD REPEAT MULTIPLY ADD REPEAT MULTIPLY ADD REPEAT...

ANSWER → $x^2 + 3x + 7$

STEPS

1. Write the known zero in the box
2. List out the coefficients
3. Bring down the 1st coefficient
4. Multiply the 1st coefficient by the box number
5. Write the product under the 2nd coefficient
6. Add down
7. Repeat
8. Use the final numbers to write polynomial

Note: Continue to walk your exponents down. Fill in all missing terms with a zero.

Example 1: Divide $(x^3 + 3x^2 - x - 3) \div (x - 1)$

1	1	3	-1	-3
	↓	1	4	3
	1	4	3	0

$x^2 + 4x + 3$

Example 2: Divide $(x^3 + 27) \div (x + 3)$

-3	1	0	0	27
	↓	-3	9	-27
	1	-3	9	0

$x^2 - 3x + 9$

You Try! Divide $(x^3 - 7x^2 - 7x + 20) \div (x + 4)$

-4	1	-7	-7	20
	↓	-4	44	-148
	1	-11	37	-128

$x^2 - 11x + 37 + \frac{-128}{x+4}$

You Try! Divide $(x^4 + 2x^2 - 20) \div (x - 2)$

2	1	0	2	0	-20
	↓	2	4	12	24
	1	2	6	12	4

$x^3 + 2x^2 + 6x + 12 + \frac{4}{x-2}$