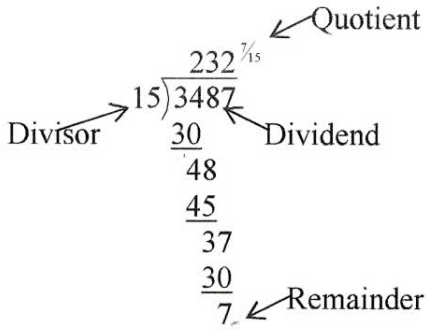
U2 Day 5 - Polynomial and Synthetic Division

SWBAT _____

Long Division... remember this process from elementary school? _____



Know these terms!

$\frac{x^2}{x} = x$

Use the same process with polynomials:

$$x+1 \overline{)\ x^2+3x+5}$$

$x+2$ R $\frac{3}{x+1}$

$-(x^2+x)$

$2x+5$

$-(2x+2)$

3

1. Take the first term x^2 and divide by the first term x
2. Multiply the first part of the answer by the divisor.
3. Draw the line, change the signs, and combine the terms.
4. Bring down the next term.

Repeat.

$\frac{2x^4}{2x} = x^3$

$$x+2 \overline{)\ 2x^2+0x+6}$$ (Use $+0x$ if there is a *missing* term!!)

$2x-4$ R $\frac{14}{x+2}$

$-(2x^2+4x)$

$-4x+6$

$-(-4x-8)$

14

$\frac{14}{x+2}$

Is $(x+2)$ a factor of the polynomial? Yes (No)

Write the factored form:

$$2x-1 \overline{)\ 2x^4+3x^3-4x^2+x+1}$$

x^3+2x^2-x

$-(2x^4-x^3)$

$4x^3-4x^2$

$-(4x^3-2x^2)$

$-2x^2+x$

$-(-2x^2+x)$

1

$\frac{1}{2x-1}$

Is $(2x-1)$ a factor of the polynomial? Yes (No)

Divide $x^4 - 10x^2 + 2x + 3$ **by** $(x-3)$

x^3+3x^2-x-1

$(x-3) \overline{)\ x^4+0x^3-10x^2+2x+3}$

$-(x^4-3x^3)$

$3x^3-10x^2$

$-(3x^3-9x^2)$

$-x^2+2x$

$-(-x^2+3x)$

$-x+3$

$-(-x+3)$

0

$\frac{3x^3}{x} = 3x^2$

$\frac{-x^2}{x} = -x$

What is the remainder? 0

This means that ($x-3$) is a FACTOR of the polynomial.

$\frac{-x}{x} = -1$

What is the quotient polynomial? x^3+3x^2-x-1

Synthetic Division (x − 3)

The divisor is **always** in the form linear factor. The **synthetic** divisor is 0 (INSIDE 3)

You **must** use a zero for each

ex. **Divide** $x^4 - 10x^2 + 2x + 3$ **by** $(x - 3)$ (Use **3** for the divisor)

(need a zero?) $x^4 + 0x^3 - 10x^2 + 2x + 3$

Form for Synthetic Division

3 | 1 0 -10 2 3 Place holder

3 9 -3 -3

1 3 -1 -1 | 0 ← Remainder

Quotient ↗

The quotient is: $x^3 + 3x^2 - x - 1$

1. Set up the synthetic division form.
2. Bring down the first # below the line
3. Multiply by 3 and put the answer above the line
4. Add

Repeat

The first term of the quotient is always **one degree less than the degree of the** dividend

Is your answer the same as the last long division problem? _____:-)

Try this:

$(x^3 - 28x - 48)$ divided by $(x + 4)$	$(x^5 - 1)$ divided by $(x - 1)$
−4 | 1 0 −28 −48 ↓ −4 16 48 1 −4 −12 | 0 The quotient is $x^2 - 4x - 12$	1 | 1 0 0 0 0 −1 ↓ 1 1 1 1 1 1 1 1 1 1 0 The quotient is $x^4 + x^3 + x^2 + x + 1$

Remainder Theorem

Ex. **For** $f(x) = 3x^2 - 5x + 7$ **find** $f(-2)$

Substitute $3(-2)^2 - 5(-2) + 7 = 29$ so $f(-2) = 29$

12 + 10 + 7

The Remainder Theorem (shortcut):

Ex: -2 | 3 -5 7

↓ -6 22

3 -11 | 29

The remainder: 29 is the same as 29

$= -2(-3)^5 + 4(-3)^3 - 5(-3)^2 + 7(-3) - 11$

Use the Remainder Theorem below to find $f(-3)$ if $f(x) = -2x^5 + 4x^3 - 5x^2 + 7x - 11$ **$f(-3)$ =**____

-3 | -2 0 4 -5 7 -11

↓ 6 -18 42 -111 312

-2 6 -14 37 -104 | 301

HW: Homework WS

The Remainder Theorem:

If a polynomial P(x) is divided by ($x - c$), the remainder in synthetic division by c is equal to P(c).

Use the Remainder Theorem to find $f(4)$ if $f(x) = 3x^4 - 4x^3 + 6x + 1$.

In Closing...

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$$\begin{array}{c|cccc} 4 & 3 & -4 & 0 & 6 & 1 \\ & & 12 & 32 & 128 & 536 \\ \hline & 3 & 8 & 32 & 134 & 537 \end{array}$$

$$3(4)^4 - 4(4)^3 + 6(4) + 1 = 537$$

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