Bellwork 9/22/16:
Describe the end behavior using limits.

\[ f(x) = 2x^6 + 4x^5 + 9x^2 \]
\[ f(x) \to \infty \text{ as } x \to -\infty \]
\[ f(x) \to \infty \text{ as } x \to \infty \]

State the number of possible zeros and turning points. Then determine all of the real zeros by factoring.

\[ f(x) = x^4 + 4x^2 - 21 = 0 \]
\[ (x^2 + 7)(x^2 - 3) = 0 \]
\[ x^2 + 7 = 0 \]
\[ x^2 = -7 \]
\[ x = \pm \sqrt{-7} \]
\[ x^2 - 3 = 0 \]
\[ x^2 = 3 \]
\[ x = \pm \sqrt{3} \]

2.2 assignment

2.3 Polynomial and Synthetic Division

Objective: SWBAT divide polynomials using long division and synthetic division.

Homework quiz #3

next class :)
**Example 1:** Use Long Division to factor completely.

\[(x^2 - 13x - 48) \div (x + 3)\]

\[\begin{array}{c|cc|c}
\text{X+3} & x^2 & -13x & -48 \\
\hline
& x^2 & +3x & \\
\hline
& -16x & -48 \\
& -16 & -48 \\
\hline
& 0 & 0
\end{array}\]  

\[(x + 3)(x - 16)\]

---

Divide using long division.

\[(6x^3 - 2x^2 - 16x - 8) \div (2x - 4)\]

\[\begin{array}{c|cccc|c}
\text{2x-4} & 6x^3 & -2x^2 & -16x & -8 \\
\hline
& 3x^3 & +5x^2 & +2x & +2 \\
\hline
& 2x^4 & -10x^3 & -2x^2 & +9x \\
& 2x^4 & +4x^3 & +8x \\
\hline
& 2x^3 & -16x & -8 \\
& 2x^3 & +4x^2 & +8x \\
\hline
& 0 & -4x & -8 \\
& -4x & -8 \\
\hline
& 0 & 0 & 0
\end{array}\]  

Divide using long division degree of 2 or higher.

\[(2x^3 + 5x^2 - 7x + 6) \div (x^2 + 3x - 4)\]

\[\begin{array}{c|ccc|c}
\text{x+3} & 2x^3 & +5x^2 & -7x + 6 \\
\hline
& 2x^3 & +6x^2 & +9x \\
\hline
& -x^2 & -7x & -6 \\
& -x^2 & -3x & -12 \\
\hline
& 0 & 4x & 6 \\
& 4x & +12 \\
\hline
& 0 & 0 & 0
\end{array}\]  

Divide using long division degree of 2 or higher.

\[(4x^3 + 10x^2 - 18x - 36) \div (4x + 6)\]

\[\begin{array}{c|cccc|c}
\text{4x+6} & 4x^3 & +10x^2 & -18x & -36 \\
\hline
& 4x^3 & +6x^2 & +9x & +9 \\
\hline
& 4x^2 & -18x & -36 \\
& 4x^2 & +6x & +9 \\
\hline
& 0 & -24x & -36 \\
& -24x & -36 \\
\hline
& 0 & 0 & 0
\end{array}\]  

Sep 21-2:34 PM
Example 2: Divide using synthetic division.

\[
(2x^4 - 5x^3 + 7x - 2) \div (x + 2)
\]

-2 | 2 0 -5 7 -2
---|---|---|---|---|---
   | -4 | 8 | -6 | -2
---|---|---|---|---|---
   | 2 | -4 | 3 | 1 | -4
---|---|---|---|---|---

\[
2x^3 - 4x^2 + 3x + 1 + \frac{-4}{x+2}
\]

Extra Example!
Divide using synthetic division completely.

\[
(6x^4 + 11x^3 - 15x^2 - 12x + 7) \div (3x + 1)
\]

Division Algorithm: If \(f(x)\) and \(d(x)\) are polynomials such that \(d(x) \neq 0\) and the degree of \(d(x)\) < the degree of \(f(x)\), there exists unique polynomials \(q(x)\) and \(r(x)\) such that

\[
f(x) = d(x)q(x) + r(x)
\]

Example 2: Write function as \(f(x) = (x - k)q(x) + r\)

\[
f(x) = x^3 - x^2 - 14x + 11, k = 4
\]

4 | 1 | -1 | -14 | 11
---|---|---|---|---|---|---
   | 4 | 12 | -8
---|---|---|---|---|---|---
   | 1 | 3 | -2 | 3
---|---|---|---|---|---|---

\[
f(x) = (x - 4)(x^2 + 3x - 2) + 3
\]
The Remainder Theorem: If a polynomial \( f(x) \) is divided by \( x - k \), the remainder is \( r = f(k) \).

*This is used to evaluate functions at given values*

\[
f(n) = -3n^3 + 6n^2 + 25n - 2 \quad \text{at} \quad n = 4; n = -1
\]

\[
\begin{array}{c|cccc}
  & 4 & 0 & 25 & -2 \\
\hline
-3 & 3 & 12 & 4 \\
0 & 3 & 4 & 2 \\
\end{array}
\]

\[
f(4) = 2
\]

\[
f(-1) = -18
\]

The Factor Theorem: A polynomial \( f(x) \) has a factor \( (x - k) \) if \( f(k) = 0 \)

**Verify factors of polynomial**

Show that \( (x - 2) \) and \( (x + 3) \) are factors of

\[
f(x) = 2x^4 + 7x^3 - 4x^2 - 27x - 18
\]

\[
\begin{array}{c|cccc}
  & 2 & 7 & -4 & -27 & -18 \\
\hline
2 & 4 & 22 & 36 & 18 & \checkmark \\
\end{array}
\]

\[
f(-2) = 0 \quad \text{(x+2) is a factor}
\]

\[
f(-3) = 0 \quad \text{(x+3) is a factor}
\]

Show that \( (x - 5) \) and \( (x + 4) \) are factors of

\[
f(x) = x^5 - 4x^3 - 15x^2 + 58x - 40
\]

\[
\begin{array}{c|cccc}
  & 5 & 15 & 58 & -40 \\
\hline
1 & 5 & 5 & -50 & 40 & \checkmark \\
\end{array}
\]

\[
f(x-5) \quad \text{is a factor}
\]

\[
\begin{array}{c|cccc}
  & -4 & -15 & 58 & -40 \\
\hline
-4 & 32 & -68 & 40 & \checkmark \\
\end{array}
\]

\[
f(x+4) \quad \text{is a factor}
\]

Summary

What can remainders tell you about a polynomial?
Coursework:

pg 156 # 12, 14, 16, 24, 28, 30, 32, 48, 50, 60, 62, 70