Algebra II
5.5 Dividing Polynomials

Obj: To divide polynomials with long division and synthetic division.

To factor polynomials given a zero.

Long Division:
- **Use standard form. (decreasing order)**
- **Put in zeros for missing terms.**
- **Keep terms lined up.**

$(2x^4 + 3x^3 + 51 - 1) \div (x^2 - 2x + 2)$

$$
\begin{array}{r}
2x^2 + 7x + 10 \\
x^2 - 2x + 2 \overline{)\, 2x^4 + 3x^3 + 0x^2 + 0x + 50} \\
-\underline{2x^4 - 4x^3 + 4x^2} \\
7x^3 - 4x^2 + 0x \\
-\underline{7x^3 - 14x^2 + 14x} \\
10x^2 - 14x + 50 \\
-\underline{10x^2 - 20x + 20} \\
6x + 30
\end{array}
$$

$2x^2 + 7x + 10 + \frac{6x + 30}{x^2 - 2x + 2}$

Long Division:
- **Use standard form. (decreasing order)**
- **Put in zeros for missing terms.**
- **Keep terms lined up.**

$(x^3 + 2x^2 - 6x - 9) \div (x - 2)$

$$
\begin{array}{r}
x^2 + 4x + 2 \\
x - 2 \overline{) x^3 + 2x^2 - 6x - 9} \\
-\underline{x^3 - 2x^2} \\
4x^2 - 6x \\
-\underline{4x^2 - 8x} \\
2x - 9 \\
\underline{2x - 4} \\
5
\end{array}
$$

$x^2 + 4x + 2 + \frac{5}{x-2}$

Synthetic Division:
- Use standard form. (decreasing order)
- Put in zeros for missing terms.
- This method is only used when dividing by x-b.
- Use <u>b</u> as the outside number. (opposite)
- The last number is the remainder.
- The numbers at the bottom of the coefficients of the solution.

$(x^3 + 2x^2 - 6x - 9) \div (x - 2)$

$$
\begin{array}{r|rrrr}
2 & 1 & 2 & -6 & -9 \\
 & & 2 & 8 & 4 \\
\hline
 & 1 & 4 & 2 & -5
\end{array}
$$

$x^2 + 4x + 2 - \frac{5}{x-2}$

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$(x^3 + 2x^2 - 6x - 9) \div (x + 3)$

$$\begin{array}{r|rrrr} -3 & 1 & 2 & -6 & -9 \\ & & -6 & 12 & -18 \\ \hline & 1 & -4 & 6 & -27 \end{array}$$

$$x^2 - 4x + 6 - \frac{27}{x+3}$$

Synthetic Division:
- Use standard form. (decreasing order)
- Put in zeros for missing terms.
- This method is only used when dividing by x-b.
- Use <u>b</u> as the outside number. (opposite)
- The last number is the remainder.
- The numbers at the bottom of the coefficients of the solution.

$(x^4 - 10x^2 - 6x - 9) \div (x + 4)$

$$\begin{array}{r|rrrrr} -4 & 1 & 0 & -10 & -6 & -9 \\ & & -4 & 16 & -24 & 120 \\ \hline & 1 & -4 & 6 & -30 & 111 \end{array}$$

$$x^3 - 4x^2 + 6x - 30 + \frac{111}{x+4}$$

Factoring:
- You will be given one "zero".
- If **b** is a zero, **x-b** is a factor.
- Start by dividing by x-b. (Put b on the outside.)
- Write the answer, (include (x-b) in front) then factor it.

Factor $f(x) = (2x^3 + 11x^2 + 18x + 9)$ if $f(-3) = 0$

$$\begin{array}{r|rrrr} -3 & 2 & 11 & 18 & 9 \\ & & -6 & -15 & -9 \\ \hline & 2 & 5 & 3 & 0 \end{array}$$

$2x^2 + 5x + 3$

$(1x+1)(2x+3)$

Factoring:
- You will be given one "zero".
- If **b** is a zero, **x-b** is a factor.
- Start by dividing by x-b.
- Write the answer, then factor it.

Factor $f(x) = (x^3 + 6x^2 + 3x - 10)$ if $f(1) = 0$

$$\begin{array}{r|rrrr} 1 & 1 & 6 & 3 & -10 \\ & & 1 & 7 & 10 \\ \hline & 1 & 7 & 10 & 0 \end{array}$$

$x^2 + 7x + 10$

$(x+5)(x+2)$