3.2 The Remainder Theorem

Division Statement:

Dividend = Divisor × Quotient + Remainder

7 = 2 × 3 + 1

OR

$\frac{\text{Dividend}}{\text{Divisor}} = \text{Quotient} + \frac{\text{Remainder}}{\text{Divisor}}$

$\frac{7}{3} = 2 + \frac{1}{3}$

Example 1: Determine the division statement:

a.) $\frac{13}{2}$

b.) $834352/7$

Long Division:

Divide: $(x^2 - 9x + 10)$ by $(x - 2)$

$$x - 2\overline{)\; x^2 - 9x + 10}$$

Compare the two leading coefficients:

1. Determine how many times x goes into x^2. That goes on top.

2. Multiply the divisor by the top and subtract from the dividend.

3. Bring down the next value in the dividend and repeat.

4. When you can no longer divide, that is your remainder.

Example 2:

a.) Divide: $(3x^3 - 5x + 10)$ by $(x + 2)$

b.) Divide: $(3x^4 - 5x^3 + 2x^2 - 6x + 10)$ by $(x^2 + 2)$

Synthetic Division:
(Different than book, but this method is more common)

1. Find a root of the divisor
2. Find the coefficients of the dividend
3. Bring down the first term
4. Multiply the outside, add the inside
5. The last number is the remainder, the second last is the constant and each term to the left is one degree higher.

Examples:
a.) Divide: $(3x^3 - 5x + 10)$ by $(x + 2)$

b.) Divide: $(3x^3 - 2x^2 - 5x + 10)$ by $(x - 1)$

c.) Divide: $(x^5 - 3x^3 + 23)$ by $(x + 1)$

The Remainder Theorem:

If the polynomial $P(x)$ is divided by $x - a$, the remainder is $P(a)$.

Example 3:

a.) What is the remainder when $P(x) = 3x^4 - 5x^2 + 6x - 2$ is divided by $(x + 1)$?

b.) For what value of k will the remainder be -2 when $P(x) = x^3 - 2x^2 + kx - 5$ is divided by $(x - 3)$?

p 124: 1-13