2.3 Polynomial and Synthetic Division

Date: _________

Long Division of Numbers

Use long division to divide 277 by 12. Then, identify the dividend, divisor, quotient, and remainder.

Long division leads to the result: $\frac{dividend}{divisor} = quotient + \frac{remainder}{divisor}$

Write the problem above in this form:

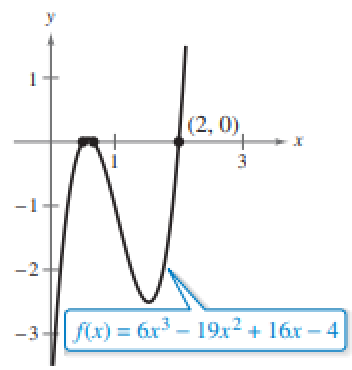
Multiplying through by the divisor yields the result: $dividend = (divisor)(quotient) + remainder$

Multiply 12 through. This can be used as a means to check your work.

Long Division of Polynomials

Learning Target*: I can divide polynomials using long division.*

Suppose you are given the graph of $f(x) = 6x^3 - 19x^2 + 16x - 4$. Notice that a zero of f occurs at $x = 2$. Because $x = 2$ is a zero of f, you know that ________ is factor of $f(x)$. This means that there exists some 2nd degree polynomial $q(x)$ such that:



$$f(x) = (x - 2) \cdot q(x)$$

To find $q(x)$, we can use **long division**!

Example 1. Use long division to divide the polynomials.

A) $(4x^3 + 2x^2 + 3x + 5) \div (x + 1)$

B) $(x^3 - 1) \div (x - 1)$

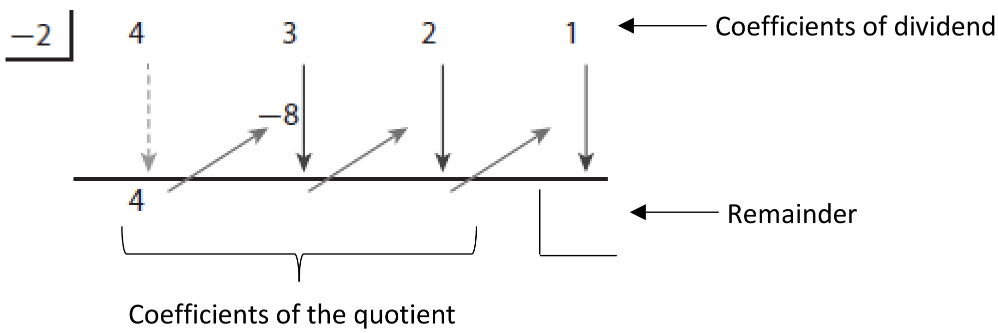
C) $(-5x^2 - 2 + 3x + 2x^4 + 4x^3) \div (2x - 3 + x^2)$

Using Synthetic Division

Learning Target: *I can use synthetic division to divide polynomials by divisors of the form $x - k$.*

There is a nice shortcut for long division of polynomials by divisors of the form x − k. The following is an example of **synthetic division**.

Use synthetic division to divide $4x^3 + 3x^2 + 2x + 1$ by $x + 2$.



<u>Example 2.</u> Use Synthetic Division to divide the polynomials.

A) $(x^4 - 10x^2 - 2x + 4) \div (x + 3)$

B) $(5x^3 + 8x^2 - x + 6) \div (x - 2)$

Using the Remainder Theorem and Factor Theorem

Learning Target: *I can apply the Remainder Theorem and Factor Theorem.*

> **The Remainder Theorem**
> If a polynomial $f(x)$ is divided by $x - k$, then the remainder is
> $r = f(k)$.

Example 3. Use the remainder theorem to evaluate $f(x) = 3x^3 + 8x^2 + 5x - 7$ given the input.

A) $x = -2$

B) $g(-1)$

> **The Factor Theorem**
> A polynomial $f(x)$ has a factor $(x - k)$ if and only if $f(k) = 0$.

Example 4. Verify the given factors of $f(x)$. Then, find the remaining factors of $f(x)$ to write $f(x)$ in factored form. Finally, give all real zeros of f.

A) $f(x) = 2x^4 + 7x^3 - 4x^2 - 27x - 18; (x - 2), (x + 3)$

B) $f(x) = x^3 - 19x - 30; (x + 3)$