Dividing Polynomials

Long Division: Another way of factor a polynomial. Similar to numerical long division.

- Both the polynomial, P(x) and divisor, D(x) need to be in standard form and input zero coefficients when needed. Process stops when the degree of the remainder, R(x) is less than the degree of the divisor.
- If no remainder is found, then the divisor is a factor of the polynomial.
- Sometimes beneficial to determine whether x a is a factor of the polynomial first. How do we do this?
 - o If x a is a factor, then it is a zero of the polynomial (meaning....when you input a into the polynomial, it should output zero).

Synthetic Division: Yet another way of factoring a polynomial.

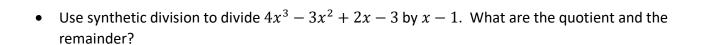
- Write down just the coefficients of the polynomial, in standard form (don't include variables or exponents).
- Don't forget "place-holders" if needed
- Divisor—reverse the sign of x a term.

Remainder Theorem: If you divide P(x) of degree $n \ge 1$ by x - a, then the remainder is equal to P(a).

Examples:

• Use long division to divide $5x^2 + 2x + 3$ by x + 1. What are the quotient and remainder?

• Is $x^2 - 2$ a factor of $P(x) = x^4 - x^2 - 2$? If it is, write P(x) as a product of two factors.



• The polynomial
$$x^3 + 9x^2 + 23x + 15$$
 expresses the volume, in cubic inches, of a box, and the length is $(x + 5)$ inches. What are the other two dimensions of the box?

• Given that
$$P(x) = x^4 + 6x^3 + 9x^2 + 3x - 3$$
, what is $P(4)$?