5.2 Evaluate and Graph Polynomial Functions

General Polynomial:

Common Polynomial Functions			
Degree	**Type**	**Standard form**	**Example**
0	constant	$f(x) = a_0$	$f(x) = 5$
1	linear	$f(x) = a_1 x^1 + a_0$ $mx + b$	$f(x) = 2x - 3$
2	quadratic	$f(x) = a_2 x^2 + a_1 x^1 + a_0$ $ax^2 + bx + c$	$f(x) = 3x^2 - x + 7$
3	cubic	$f(x) = a_3 x^3 + a_2 x^2 + a_1 x^1 + a_0$	$f(x) = 2x^3 - x^2 - x + 1$

4 quartic

5 quintic

EXAMPLE 1 **Identify polynomial functions**

Decide whether the function is a polynomial function. If so, write it in standard form and state its degree, type, and leading coefficient.

$$h(x) = x^4 - \frac{1}{4}x^2 + 3$$

$$k(x) = x + 2^x - 0.6x^5$$

polynomial

$$h(x) = x^4 - \frac{1}{4}x^2 + 3$$

deg: 4   Leading coeff.: 1

type: quartic

Not a poly.

$$f(x) = 5x^2 + 3x^{-1} - x$$

$$g(x) = 7x - \sqrt{3} + \pi x^2$$

Not a poly

Yes it's a poly.

$$g(x) = \pi x^2 + 7x - \sqrt{3}$$

deg: 2   type: quadratic

L.C. = π

EXAMPLE 2   **Evaluate by direct substitution**

Use direct substitution to evaluate the polynomial function for the given value of x.

$$f(x) = x^4 + 2x^3 + 3x^2 - 7; x = -2$$

$$(-2)^4 + 2(-2)^3 + 3(-2)^2 - 7$$

$$16 - 16 + 12 - 7$$

$$\boxed{5}$$

EXAMPLE 2   **Evaluate by direct substitution**

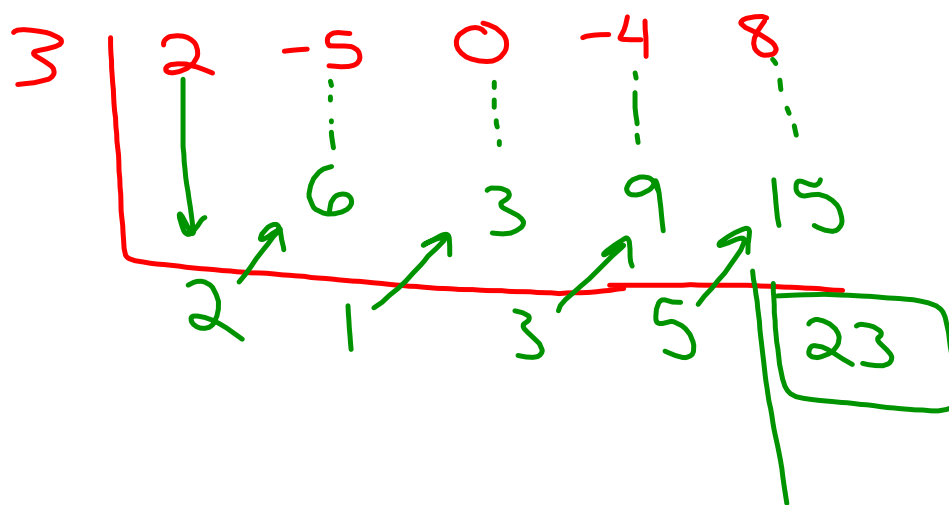Use direct substitution to evaluate $f(x) = 2x^4 - 5x^3 - 4x + 8$ when $x = 3$.

$$2(3)^4 - 5(3)^3 - 4(3) + 8$$

$$162 - 135 - 12 + 8$$

$$\boxed{23}$$

EXAMPLE 3 Evaluate by synthetic substitution

Use synthetic substitution to evaluate $f(x) = 2x^4 - 5x^3 - 4x + 8$ when $x = 3$.

$$
\begin{array}{r|rrrrr}
3 & 2 & -5 & 0 & -4 & 8 \\
  &   & 6 & 3 & 9 & 15 \\
\hline
  & 2 & 1 & 3 & 5 & \boxed{23}
\end{array}
$$

EXAMPLE 3   **Evaluate by synthetic substitution**

Use synthetic substitution to evaluate the polynomial
function for the given value of x.

$$f(x) = 5x^3 + 3x^2 - x + 7; x = 2$$

$$
\begin{array}{c|cccc}
2 & 5 & 3 & -1 & 7 \\
  &   & 10 & 26 & 50 \\
\hline
  & 5 & 13 & 25 & 57 \\
\end{array}
$$

$$\boxed{57}$$

EXAMPLE 3   **Evaluate by synthetic substitution**

Use synthetic substitution to evaluate the polynomial function for the given value of x.

$$g(x) = -2x^4 - x^3 + 4x - 5; \; x = -1$$

$$
\begin{array}{r|rrrrr}
-1 & -2 & -1 & 0 & 4 & -5 \\
   &   & 2 & -1 & 1 & -5 \\
\hline
   & -2 & 1 & -1 & 5 & -10 \\
\end{array}
$$

$$\boxed{-10}$$