5.2a – Evaluate Polynomial Functions

Polynomial Functions – the sums and differences of monomial functions
Degree of a Polynomial – the term with the highest variable exponent
Leading Coefficient – the coefficient of the variable with the highest exponent

Degree	Type	Standard Form	Example
0	Constant	$f(x) = a_0$	$f(x) = -14$ $x^0 = 1$
1	Linear	$f(x) = a_1x + a_0$	$f(x) = 5x - 7$
2	Quadratic	$f(x) = a_2x^2 + a_1x + a_0$	$f(x) = 2x^2 + x - 9$
3	Cubic	$f(x) = a_3x^3 + a_2x^2 + a_1x + a_0$	$f(x) = x^3 - x^2 + 3x$
4	Quartic	$f(x) = a_4x^4 + a_3x^3 + a_2x^2 + a_1x + a_0$	$f(x) = x^4 + 2x - 1$

Example 1 Decide whether the function is a polynomial function. If so, write it in standard form and state its degree, type, and leading coefficient

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

Yes $x^4 - \frac{1}{4}x^2 + 3$

D → 4, Quartic

LC → 1

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

Yes, $\pi x^2 + 7x - \sqrt{3}$

D → 2, Quadratic

LC → π

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

No. −1 is not a whole # exponent

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

no. a polynomial cannot have a variable exponent

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

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

$= 2(81) - 5(27) - 12 + 8$

$= 162 - 135 - 4$

$f(3) = 23$

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

3	2	-5	0	-4	8
x's	↓	6	3	9	15
	2	1	3	5	23

→ $f(3) = 23$

HW: (3-12), (15-20)

PLE 1
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3–8

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.**

3. $f(x) = 8 - x^2$
4. $f(x) = 6x + 8x^4 - 3$
5. $g(x) = \pi x^4 + \sqrt{6}$
6. $h(x) = x^3\sqrt{10} + 5x^{-2} + 1$
7. $h(x) = -\frac{5}{2}x^3 + 3x - 10$
8. $g(x) = 8x^3 - 4x^2 + \frac{2}{x}$

PLE 2
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9–14

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

9. $f(x) = 5x^3 - 2x^2 + 10x - 15;\ x = -1$
10. $f(x) = 8x + 5x^4 - 3x^2 - x^3;\ x = 2$
11. $g(x) = 4x^3 - 2x^5;\ x = -3$
12. $h(x) = 6x^3 - 25x + 20;\ x = 5$
13. $h(x) = x + \frac{1}{2}x^4 - \frac{3}{4}x^3 + 10;\ x = -4$
14. $g(x) = 4x^5 + 6x^3 + x^2 - 10x + 5;\ x = -2$

PLE 3
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15–23

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

15. $f(x) = 5x^3 - 2x^2 - 8x + 16;\ x = 3$
16. $f(x) = 8x^4 + 12x^3 + 6x^2 - 5x + 9;\ x = -2$
17. $g(x) = x^3 + 8x^2 - 7x + 35;\ x = -6$
18. $h(x) = -8x^3 + 14x - 35;\ x = 4$
19. $f(x) = -2x^4 + 3x^3 - 8x + 13;\ x = 2$
20. $g(x) = 6x^5 + 10x^3 - 27;\ x = -3$
21. $h(x) = -7x^3 + 11x^2 + 4x;\ x = 3$
22. $f(x) = x^4 + 3x - 20;\ x = 4$