

Chapter 8 - The World of Polynomials

Objective: I can classify polynomials and identify their structural features using standard form.

For Questions 1-8, use precise vocabulary and write every polynomial in descending powers.

1. For $7x^4 - 3x^2 + 5$, state the degree, leading term, leading coefficient, constant term, number of nonzero terms, and classification.	2. For $-2x^3 + x - 9$, state the degree, leading term, leading coefficient, constant term, number of nonzero terms, and classification.
3. Write $6 - 4x^5 + x^2$ in standard form. Then state its degree, leading coefficient, and number of nonzero terms.	4. Which expression is a polynomial? Explain each rejection: $\sqrt{x} + 2$, $\frac{3}{x} - 1$, or $2x^3 - x + 1$.
5. Combine like terms and write in standard form: $4x^3 - 2x + 7 + 3x^2 - 5x^3 + 9$.	6. Find the degree of $5a^3b^2 - 2a^2b^4 + 7$. Explain how total degree is determined.
7. For $p(t) = -\frac{1}{2}t^6 + 4t^3 - 9$, state the leading term, leading coefficient, degree, and constant term.	8. Construct a polynomial of degree 4 with leading coefficient -3, constant term 8, and exactly three nonzero terms.

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Objective: I can evaluate polynomials and combine them by addition and subtraction.

For Questions 9-16, preserve parentheses and show the substitution or vertical alignment used.

9. If $P(x) = 2x^3 - 5x + 1$, find $P(-2)$.	10. If $Q(a) = -a^4 + 3a^2 - 7$, find $Q(-3)$.
11. Let $A(x) = 3x^2 - 2x + 5$ and $B(x) = -x^2 + 4x - 7$. Find $A(x) + B(x)$.	12. Using the same $A(x)$ and $B(x)$, find $A(x) - B(x)$.
13. Simplify $(5y^3 - 2y + 9) + (-3y^3 + 4y^2 + y - 6)$.	14. Simplify $(8m^4 - m^2 + 3) - (2m^4 + 5m^2 - 7)$.
15. Find $R(x)$ if $R(x) + (2x^2 - 3x + 4) = 5x^2 + x - 8$.	16. Let $P(x) = x^3 - 2x^2 + 4$ and $Q(x) = 3x^2 - x - 5$. Find $P(-1) + Q(2)$.

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Objective: I can multiply monomials, binomials, and polynomials and report products in standard form.

Show every distribution step and combine like terms only after multiplying.

17. Expand $4x^3(-2x^4 + 5x - 7)$.	18. Expand $-3a^2b(2ab^3 - 4a^2b + 5)$.
19. Expand $(x + 5)(x - 3)$.	20. Expand $(2x - 1)(x + 6)$.
21. Expand $(3y + 4)(2y - 5)$.	22. Expand $(x^2 + 2x - 1)(x + 3)$.
23. Expand $(2m^2 - m + 3)(m - 2)$.	24. A rectangle has dimensions $3x + 2$ and $2x - 5$. Write its area as a polynomial in standard form.

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Objective: I can apply special-product and sum-or-difference identities accurately.

Name or display the identity used whenever it shortens the multiplication.

25. Expand $(x + 7)^2$.	26. Expand $(3x - 2)^2$.
27. Expand $(5y + 1)(5y - 1)$.	28. Expand $(2a + 3b)^2$.
29. Find k if $(x + k)^2 = x^2 + 12x + 36$ for every real x.	30. Simplify $(x + 4)^2 - (x - 4)^2$.
31. Expand and simplify $(x + 2)(x^2 - 2x + 4)$.	32. Expand and simplify $(2x - 3)(4x^2 + 6x + 9)$.

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Objective: I can divide polynomials and apply the Remainder and Factor Theorems.

Show the term-by-term division, synthetic table, or direct substitution used.

33. Simplify $\frac{18x^7 - 12x^4 + 6x^2}{6x^2}$.	34. Simplify $\frac{-15a^6b^3 + 10a^4b^2 - 5a^2b}{5a^2b}$.
35. Divide $x^3 + 5x^2 + 2x - 8$ by $x + 4$. State the quotient and remainder.	36. Divide $2x^3 - 3x^2 - 11x + 6$ by $x - 3$. State the quotient and remainder.
37. Find the remainder when $P(x) = 2x^3 - x^2 + 4x - 5$ is divided by $x - 2$.	38. Find k so that $x + 1$ is a factor of $x^3 + kx^2 - 4x - 4$.

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Objective: I can create, simplify, and evaluate polynomial models from context.

Define the requested quantity and include appropriate units when evaluating.

39. A rectangle has length $4x^2 + x - 3$ and width $x^2 - 2x + 5$. Write its perimeter as a polynomial.	40. A rectangular prism has dimensions x, $x + 2$, and $x + 5$. Write its volume as a polynomial.
41. Revenue is $R(x) = 80x$ and cost is $C(x) = 2x^2 + 35x + 120$. Find the profit polynomial $P(x) = R(x) - C(x)$.	42. A square border surrounds an inner square of side x. The outer square has side $x + 4$. Find the border area polynomial.
43. Height is modeled by $h(t) = -16t^2 + 64t + 5$. Find $h(2)$ and state the unit as feet.	44. A square has side $3x - 2$. Write its area polynomial and evaluate the area when $x = 4$.

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Objective: I can verify identities and diagnose errors in polynomial reasoning.

A complete response must identify the algebraic principle involved.

45. Verify that $(x + 1)(x^2 - x + 1) = x^3 + 1$ for every real x.	46. A student writes $(2x - 3)(x + 4) = 2x^2 + 5x + 12$. Identify the error and give the correct product.
47. A student writes $(3x^2 + 2x - 1) + (x^2 - 5x + 4) = 4x^4 - 3x + 3$. Identify the error and correct the sum.	48. Determine whether $x^4 + 2x^2 + 1$ and $(x^2 + 1)^2$ are identical. Prove your conclusion.

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Objective: I can determine unknown coefficients and simplify challenging polynomial expressions efficiently.

Write a complete derivation. Answers without supporting algebra are incomplete.

49. Let $P(x) = ax^2 + bx + c$. Find $P(x)$ if $P(0) = 3$, $P(1) = 8$, and $P(-1) = 2$.

50. Simplify $(x+1)^4 - (x-1)^4$ without separately expanding both fourth powers. Explain the identity used.

Other topics for review:

- Standard form uses descending powers and combines all like terms.
- Degree is determined by the greatest exponent or greatest total degree of a term.
- Addition combines coefficients; multiplication adds exponents of like bases.
- A subtraction sign changes every term inside the following parentheses.
- Special products, synthetic division, and theorem checks should be verified algebraically.