

12.5 Exercises

Concept Check

Fill-in-the-Blank. Complete each sentence using information found in this section.

- To find the difference between two polynomials, first change the _____ of each term in the second polynomial.
- If there are multiple grouping symbols within an algebraic expression, begin working on the _____ pair of symbols first.
- To add two or more polynomials, combine _____ terms.
- A negative sign written in front of a polynomial in parentheses indicates the _____ of the entire polynomial.
- To simplify algebraic expressions, apply the rules for order of operations just as if the _____ were numbers and proceed to combine like terms.
- Like terms have the same _____ raised to the same _____.

True/False. Determine whether each statement is true or false. If a statement is false, explain how it can be changed so the statement will be true. (**Note:** There may be more than one acceptable change.)

- When subtracting one polynomial from another polynomial, only the first term of the polynomial is subtracted.
- To simplify polynomials that are being added and subtracted, combine like terms.
- The terms $6a^2$ and $7a^2$ are not like terms because they don't have the same coefficient.
- Absolute value bars and radical signs are not considered grouping symbols.

Practice

Find the indicated sums. See Examples 1 through 3.

- $(2x^2 + 5x - 1) + (x^2 + 2x + 3)$
- $(x^2 + 3x - 8) + (3x^2 - 2x + 4)$
- $(x^2 + 7x - 7) + (x^2 + 4x)$
- $(x^2 + 2x - 3) + (x^2 + 5)$
- $(-4x^2 + 2x - 1) + (3x^2 - x + 2) + (x - 8)$
- $(8x^2 + 5x + 2) + (-3x^2 + 9x - 4) + (2x^2 + 6)$
- $(x^2 + 2x - 1) + (3x^2 - x + 2) + (2x^3 - 4x - 8)$
- $(x^3 + 2x - 9) + (x^2 - 5x + 2) + (x^3 - 4x^2 + 1)$
- $(2x^2 - x - 1) + (x^2 + x + 1)$
- $(3x^2 + 5x - 4) + (2x^2 + x - 6)$
- $(-2x^2 - 3x + 9) + (3x^2 - 2x + 8)$
- $(x^2 + 6x - 7) + (3x^2 + x - 1)$

$$13. \quad \begin{array}{r} x^2 + 4x - 4 \\ -2x^2 + 3x + 1 \\ \hline \end{array}$$

$$14. \quad \begin{array}{r} 2x^2 + 4x - 3 \\ 3x^2 - 9x + 2 \\ \hline \end{array}$$

$$15. \quad \begin{array}{r} x^3 + 3x^2 + x \\ -2x^3 - x^2 + 2x - 4 \\ \hline \end{array}$$

$$16. \quad \begin{array}{r} 4x^3 + 5x^2 + 11 \\ 2x^3 - 2x^2 - 3x - 6 \\ \hline \end{array}$$

$$17. \quad \begin{array}{r} 7x^3 + 5x^2 + x - 6 \\ -3x^2 + 4x + 11 \\ -3x^3 - 2x^2 - 5x + 2 \\ \hline \end{array}$$

$$18. \quad \begin{array}{r} x^3 + 5x^2 + 7x - 3 \\ 4x^2 + 3x - 9 \\ 4x^3 + 2x^2 - 2 \\ \hline \end{array}$$

$$19. \quad \begin{array}{r} x^3 + 3x^2 - 4 \\ 7x^2 + 2x + 1 \\ x^3 + x^2 - 6x \\ \hline \end{array}$$

$$20. \quad \begin{array}{r} x^3 + 2x^2 - 5 \\ -2x^3 + x - 9 \\ x^3 - 2x^2 + 14 \\ \hline \end{array}$$

Find the indicated differences. See Examples 4 through 6.

$$21. \quad (2x^2 + 4x + 8) - (x^2 + 3x + 2)$$

$$24. \quad (6x^2 + 11x + 2) - (4x^2 - 2x - 7)$$

$$22. \quad (3x^2 + 7x - 6) - (x^2 + 2x + 5)$$

$$25. \quad (2x^2 - x - 10) - (-x^2 + 3x - 2)$$

$$23. \quad (x^2 - 9x + 2) - (4x^2 - 3x + 4)$$

$$26. \quad (7x^2 + 4x - 9) - (-2x^2 + x - 9)$$

$$27. \quad (x^4 + 8x^3 - 2x^2 - 5) - (2x^4 + 10x^3 - 2x^2 + 11)$$

$$28. \quad (x^3 + 4x^2 - 3x - 7) - (3x^3 + x^2 + 2x + 1)$$

$$29. \quad (-3x^4 + 2x^3 - 7x^2 + 6x + 12) - (x^4 + 9x^3 + 4x^2 + x - 1)$$

$$30. \quad (2x^5 + 3x^3 - 2x^2 + x - 5) - (3x^5 - 2x^3 + 5x^2 + 6x - 1)$$

$$31. \quad (9x^2 - 5) - (13x^2 - 6x - 6)$$

$$32. \quad (8x^2 + 9) - (4x^2 - 3x - 2)$$

$$33. \quad (3x^4 - 2x^3 - 8x - 1) - (5x^3 - 3x^2 - 3x - 10)$$

$$34. \quad (x^5 + 6x^3 - 3x^2 - 5) - (2x^5 + 8x^3 + 5x + 17)$$

$$35. \quad \begin{array}{r} 14x^2 - 6x + 9 \\ -(8x^2 + x - 9) \\ \hline \end{array}$$

$$38. \quad \begin{array}{r} 11x^2 + 5x - 13 \\ -(-3x^2 + 5x + 2) \\ \hline \end{array}$$

$$36. \quad \begin{array}{r} 9x^2 - 3x + 2 \\ -(4x^2 - 5x - 1) \\ \hline \end{array}$$

$$39. \quad \begin{array}{r} x^3 + 6x^2 - 3 \\ -(-x^3 + 2x^2 - 3x + 7) \\ \hline \end{array}$$

$$37. \quad \begin{array}{r} 5x^4 + 8x^2 + 11 \\ -(-3x^4 + 2x^2 - 4) \\ \hline \end{array}$$

$$40. \quad \begin{array}{r} 3x^3 + 9x - 17 \\ -(x^3 + 5x^2 - 2x - 6) \\ \hline \end{array}$$

Simplify each of the following expressions. See Examples 7 and 8.

41. $5x + 2(x - 3) - (3x + 7)$

42. $-4(x - 6) - (8x + 2) - 3x$

43. $11 + [3x - 2(1 + 5x)]$

44. $2 + [9x - 4(3x + 2)]$

45. $8x - [2x + 4(x - 3) - 5]$

46. $17 - [-3x + 6(2x - 3) + 9]$

47. $3x^3 - [5 - 7(x^2 + 2) - 6x^2]$

48. $10x^3 - [8 - 5(3 - 2x^2) - 7x^2]$

49. $(2x^2 + 4) - [-8 + 2(7 - 3x^2) + x]$

50. $-[6x^2 - 3(4 + 2x) + 9] - (x^2 + 5)$

51. $2[3x + (x - 8) - (2x + 5)] - (x - 7)$

52. $3[x + (10 - 3x) - (8 - 3x)] + (2x - 1)$

53. $(x^2 - 1) + 2[4 + (3 - x)]$

54. $(4 - x^2) + 3[(2x - 3) - 5]$

55. $-(x - 5) + [6x - 2(4 - x)]$

56. $2(2x + 1) - [5x - (2x + 3)]$

Complete the following word problems.

57. Find the sum of $4x^2 - 3x$ and $6x + 5$.

58. Subtract $2x^2 - 4x$ from $7x^3 + 5x$.

59. Subtract $3(x + 1)$ from $5(2x - 3)$.

60. Find the sum of $10x - 2(3x + 5)$ and $3(x - 4) + 16$.

61. Subtract $3x^2 - 4x + 2$ from the sum of $4x^2 + x - 1$ and $6x - 5$.

62. Subtract $-2x^2 + 6x + 12$ from the sum of $2x^2 + 3x - 1$ and $x^2 - 13x + 2$.

63. Add $5x^3 - 8x + 1$ to the difference between $2x^3 + 14x - 3$ and $x^2 + 6x + 5$.

64. Add $2x^3 + 4x^2 + 1$ to the difference between $-x^2 + 10x - 3$ and $x^3 + 2x^2 + 4x$.

Applications

Solve.

65. A manufacturer estimates that it costs $2x^3 + 4x^2 - 35$ dollars to create the amount of items it would take to fill a box which has a side length of x feet. The warehouse manager determines it will cost $1.50x^3 + 5$ dollars to store each box for one month.
- Add the two polynomials to determine the manufacturing and storage costs for each box of items for one month.
 - The warehouse manager knows that each box will be stored for an average of 3 months. Determine the cost to produce a box of items and store it for 3 months.
 - If the box has a side length of 4 feet, use the expression from part b. to determine how much will it cost to create and store a box of items for 3 months.

66. Carson has two loans, a loan for his car and a home equity loan that he used for home improvements. The car loan is for \$15,000 and Carson plans to make monthly payments of \$500 per month. The home improvement loan is for \$9000 and Carson plans to make monthly payments of \$300.
- Write an algebraic expression to describe the value of the car loan after x months.
 - Write an algebraic expression to describe the value of the home equity loan after x months.
 - Add together the two algebraic expressions to determine the remaining loan amount to be paid after x months for both loans combined.
 - How much will Carson still owe on both loans after 10 months?
67. A company estimates that the revenue from selling x items is $58x$ dollars and the cost of producing x items is $31x + 40$ dollars.
- The company's profit is defined as revenue minus cost. Find the expression that models the profit of producing and selling x items.
 - What is the profit from producing and selling 12 items?
68. Keri's gym membership costs \$30 a month plus \$6 for every class she takes. To cut back on her spending, she is thinking of switching to a gym that costs \$20 a month plus \$4 for every class she takes.
- Write an algebraic expression that describes how much Keri is currently paying per month if she takes x classes.
 - Write an algebraic expression that describes how much Keri would pay per month at the new gym if she took x classes.
 - Write an algebraic expression that describes Keri's savings per month if she switches gyms.
 - How much would Keri save the first month if she switches gyms and takes 10 classes?

Writing & Thinking

69. Explain, in your own words, how to subtract one polynomial from another.
70. Give two examples that show how the sum of two binomials might not be a binomial.