Practice 9-1

Adding and Subtracting Polynomials

**Write each polynomial in standard form. Then name each polynomial based
on its degree and number of terms.**

1. $4y^3 - 4y^2 + 3 - y$

2. $x^2 + x^4 - 6$

3. $x + 2$

4. $2m^2 - 7m^3 + 3m$

5. $4 - x + 2x^2$

6. $7x^3 + 2x^2$

7. $n^2 - 5n$

8. $6 + 7x^2$

9. $3a^2 + a^3 - 4a + 3$

10. $5 + 3x$

11. $7 - 8a^2 + 6a$

12. $5x + 4 - x^2$

13. $2 + 4x^2 - x^3$

14. $4x^3 - 2x^2$

15. $y^2 - 7 - 3y$

16. $x - 6x^2 - 3$

17. $v^3 - v + 2v^2$

18. $8d + 3d^2$

Simplify. Write each answer in standard form.

19. $(3x^2 - 5x) - (x^2 + 4x + 3)$

20. $(2x^3 - 4x^2 + 3) + (x^3 - 3x^2 + 1)$

21. $(3y^3 - 11y + 3) - (5y^3 + y^2 + 2)$

22. $(3x^2 + 2x^3) - (3x^2 + 7x - 1)$

23. $(2a^3 + 3a^2 + 7a) + (a^3 + a^2 - 2a)$

24. $(8y^3 - y + 7) - (6y^3 + 3y - 3)$

25. $(x^2 - 6) + (5x^2 + x - 3)$

26. $(5n^2 - 7) - (2n^2 + n - 3)$

27. $(5n^3 + 2n^2 + 2) - (n^3 + 3n^2 - 2)$

28. $(3y^2 - 7y + 3) - (5y + 3 - 4y^2)$

29. $(2x^2 + 9x - 17) + (x^2 - 6x - 3)$

30. $(3 - x^3 - 5x^2) + (x + 2x^3 - 3)$

31. $(3x + x^2 - x^3) - (x^3 + 2x^2 + 5x)$

32. $(d^2 + 8 - 5d) - (5d^2 + d - 2d^3 + 3)$

33. $(3x^3 + 7x^2) + (x^2 - 2x^3)$

34. $(6c^2 + 5c - 3) - (3c^2 + 8c)$

35. $(3y^2 - 5y - 7) + (y^2 - 6y + 7)$

36. $(3c^2 - 8c + 4) - (7 + c^2 - 8c)$

37. $(4x^2 + 13x + 9) + (12x^2 + x + 6)$

38. $(2x - 13x^2 + 3) - (2x^2 + 8x)$

39. $(7x - 4x^2 + 11) + (7x^2 + 5)$

40. $(4x + 7x^3 - 9x^2) + (3 - 2x^2 - 5x)$

41. $(y^3 + y^2 - 2) + (y - 6y^2)$

42. $(x^2 - 8x - 3) - (x^3 + 8x^2 - 8)$

43. $(3x^2 - 2x + 9) - (x^2 - x + 7)$

44. $(2x^2 - 6x + 3) - (2x + 4x^2 + 2)$

45. $(2x^2 - 2x^3 - 7) + (9x^2 + 2 + x)$

46. $(3a^2 + a^3 - 1) + (2a^2 + 3a + 1)$

47. $(2x^2 + 3 - x) - (2 + 2x^2 - 5x)$

48. $(n^4 - 2n - 1) + (5n - n^4 + 5)$

49. $(x^3 + 3x) - (x^2 + 6 - 4x)$

50. $(7s^2 + 4s + 2) + (3s + 2 - s^2)$

51. $(6x^2 - 3x + 9) - (x^2 + 3x - 5)$

52. $(3x^3 - x^2 + 4) + (2x^3 - 3x + 9)$

53. $(y^3 + 3y - 1) - (y^3 + 3y + 5)$

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

55. $(x^2 + 15x + 13) + (3x^2 - 15x + 7)$

56. $(7 - 8x^2) + (x^3 - x + 5)$

57. $(2x + 3) - (x - 4) + (x + 2)$

58. $(x^2 + 4) - (x - 4) + (x^2 - 2x)$

Practice 9-2

Simplify each product.

1. $4(a - 3)$

2. $-5(x - 2)$

3. $-3x^2(x^2 + 3x)$

4. $4x^3(x - 3)$

5. $-5x^2(x^2 + 2x + 1)$

6. $3x(x^2 - 5x - 3)$

7. $-x^2(-2x^2 + 3x - 2)$

8. $4d^2(d^2 - 3d - 7)$

9. $5m^3(m + 6)$

10. $a^2(2a + 4)$

11. $4(x^2 - 3) + x(x + 1)$

12. $4x(5x - 6)$

Find the GCF of the terms of each polynomial.

13. $8x - 4$

14. $15x + 45x^2$

15. $x^2 + 3x$

16. $4c^3 - 8c^2 + 8$

17. $12x - 36$

18. $12n^3 + 4n^2$

19. $14x^3 + 7x^2$

20. $8x^3 - 12x$

21. $9 - 27x^3$

22. $25x^3 - 15x^2$

23. $11x^2 - 33x$

24. $4n^4 + 6n^3 - 8n^2$

25. $8d^3 + 4d^2 + 12d$

26. $6x^2 + 12x - 21$

27. $8g^2 + 16g - 8$

Factor each polynomial.

28. $8x + 10$

29. $12n^3 - 8n$

30. $14d - 2$

31. $6h^2 - 8h$

32. $3z^4 - 15z^3 - 9z^2$

33. $3y^3 - 8y^2 - 9y$

34. $x^3 - 5x^2$

35. $8x^3 - 12x^2 + 4x$

36. $7x^3 + 21x^4$

37. $6a^3 - 12a^2 + 14a$

38. $6x^4 + 12x^2$

39. $3n^4 - 6n^2 + 9n$

40. $2w^3 + 6w^2 - 4w$

41. $12c^3 - 30c^2$

42. $2x^2 + 8x - 14$

43. $4x^3 + 12x^2 + 16x$

44. $16m^3 - 8m^2 + 12m$

45. $4a^3 - 20a^2 - 8a$

46. $18c^4 - 9c^2 + 7c$

47. $6y^4 + 9y^3 - 27y^2$

48. $6c^2 - 3c$

49. A circular pond will be placed on a square piece of land. The length of a side of the square is $2x$. The radius of the pond is x. The part of the square not covered by the pond will be planted with flowers. What is the area of the region that will be planted with flowers? Write your answer in factored form.

50. A square poster of length $3x$ is to have a square painting centered on it. The length of the painting is $2x$. The area of the poster not covered by the painting will be painted black. What is the area of the poster that will be painted black?

51. The formula for the surface area of a sphere is $A = 4\pi r^2$. A square sticker of side x is placed on a ball of radius $3x$. What is the surface area of the sphere not covered by the sticker? Write your answer in factored form.

Practice 9-3

Simplify each product. Write in standard form.

1. $(x + 3)(2x - 5)$

2. $(x^2 + x - 1)(x + 1)$

3. $(3w + 4)(2w - 1)$

4. $(x + 5)(x + 4)$

5. $(2b - 1)(b^2 - 3b + 4)$

6. $(a - 11)(a + 5)$

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

8. $(3s - 4)(s - 5)$

9. $(4x + 3)(x - 7)$

10. $(x + 6)(x^2 - 4x + 3)$

11. $(5x - 3)(4x + 2)$

12. $(3y + 7)(4y + 5)$

13. $(3x + 7)(x + 5)$

14. $(5x - 2)(x + 3)$

15. $(3m^2 - 7m + 8)(m - 2)$

16. $(a - 6)(a + 8)$

17. $(x + 2)(2x^2 - 3x + 2)$

18. $(a^2 + a + 1)(a - 1)$

19. $(x - 2)(x^2 + 4x + 4)$

20. $(2r + 1)(3r - 1)$

21. $(k + 4)(3k - 4)$

22. $(2n - 3)(n^2 - 2n + 5)$

23. $(p - 4)(2p + 3)$

24. $(3x + 1)(4x^2 - 2x + 1)$

25. $(2x^2 - 5x + 2)(4x - 3)$

26. $(x + 7)(x + 5)$

27. $(6x - 11)(x + 2)$

28. $(2x + 1)(4x + 3)$

29. $(3x + 4)(3x - 4)$

30. $(6x - 5)(3x + 1)$

31. $(n - 7)(n + 4)$

32. $(3x - 1)(2x + 1)$

33. $(d + 9)(d - 11)$

34. $(2x^2 + 5x - 3)(2x + 1)$

35. $(b + 8)(2b - 5)$

36. $(2x - 5)(x + 4)$

37. $(3x + 5)(5x - 7)$

38. $(x - 5)(2x^2 - 7x - 2)$

39. $(2x^2 - 9x + 11)(2x + 1)$

40. $(2x^2 + 5x - 4)(2x + 7)$

41. $(x^2 + 6x + 11)(3x + 5)$

42. $(5x + 7)(7x + 3)$

43. $(4x - 7)(2x - 5)$

44. $(x - 9)(3x + 5)$

**45.** $(2x - 1)(x^2 - 7x + 1)$

46. The width of a rectangular painting is 3 in. more than twice the height. A frame that is 2.5 in. wide goes around the painting.

   a. Write an expression for the combined area of the painting and frame.

   b. Use the expression to find the combined area when the height of the painting is 12 in.

   c. Use the expression to find the combined area when the height of the painting is 15 in.

47. The Robertsons put a rectangular pool with a stone walkway around it in their backyard. The total length of the pool and walkway is 3 times the total width. The walkway is 2 ft wide all around.

   a. Write an expression for the area of the pool.

   b. Find the area of the pool when the total width is 10 ft.

   c. Find the area of the pool when the total width is 9 ft.

48. The Cutting Edge frame shop makes a mat by cutting out the inside of a rectangular board. Use the diagram to find the length and width of the original board if the area of the mat is 184 in^2.
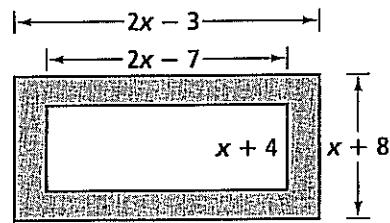
Practice 9-4

Simplify.

1. $(w - 2)^2$

2. $(y + 4)^2$

3. $(4w + 2)^2$

4. $(w - 9)^2$

5. $(3x + 7)^2$

6. $(3x - 7)^2$

7. $(2x - 9)^2$

8. $(x - 12)^2$

9. $(6x + 1)^2$

10. $(4x - 7)^2$

11. $(x + 8)(x - 8)$

12. $(x - 11)(x + 11)$

13. $(x - 12)(x + 12)$

14. $(y + w)(y - w)$

15. $(2x + 1)(2x - 1)$

16. $(5x - 2)(5x + 2)$

17. $(6x + 1)(6x - 1)$

18. $(2x - 4)(2x + 4)$

19. $(x^2 + y^2)^2$

20. $(2x^2 + y^2)^2$

21. $(a^2 - b^2)^2$

22. $(y^2 - 4w^2)^2$

23. $(3 - 6x^2)^2$

24. $(4a - 3y)^2$

25. $(3y + 2a)(3y - 2a)$

26. $(x^2 + 2y)(x^2 - 2y)$

27. $(3x^2 + 4w^2)(3x^2 - 4w^2)$

28. $(4x + 3w^2)(4x - 3w^2)$

29. $(2a + 7b)(2a - 7b)$

30. $(5a^2 - 6x)(5a^2 + 6x)$

31. 18^2

32. $(64)^2$

33. $(29)(31)$

34. $(97)(103)$

35. $(19)(42)$

36. $(95)(205)$

Find the area.

37.

$2x + 1$
$2x + 1$

38.

$3x - 2$
$3x + 2$
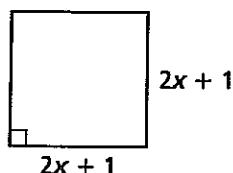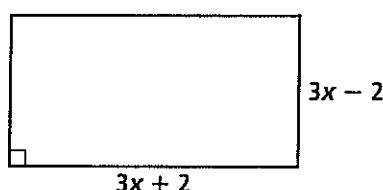
Find the area of the shaded region.

39.

x
x
$x + 11$
$x + 11$

40.

$x + 9$
x
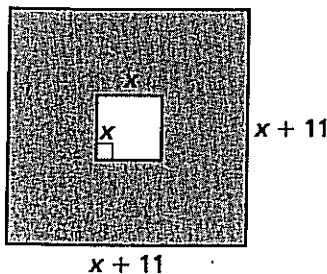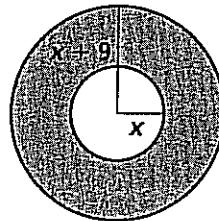
Practice 9-5

Factoring Trinomials of the Type $x^2 + bx + c$

Factor each expression.

1. $x^2 + 8x + 16$

2. $d^2 + 8d + 7$

3. $y^2 + 6y + 8$

4. $b^2 - 2b - 3$

5. $s^2 - 4s - 5$

6. $x^2 + 12x + 32$

7. $x^2 - 9x + 20$

8. $x^2 - 5x + 6$

9. $a^2 + 3a + 2$

10. $p^2 - 8p + 7$

11. $d^2 + 6d + 5$

12. $n^2 + n - 6$

13. $x^2 + 5x - 14$

14. $b^2 + 9b + 14$

15. $x^2 + 14x + 45$

16. $a^2 + 7a + 12$

17. $x^2 + 13x + 22$

18. $x^2 + 3x - 4$

19. $x^2 - 8x + 12$

20. $x^2 + 7x - 18$

21. $n^2 - 7n + 10$

22. $s^2 - 5s - 14$

23. $x^2 - 9x + 8$

24. $x^2 - 2x - 24$

25. $x^2 - 6x - 27$

26. $x^2 - 16x - 36$

27. $x^2 + 7x + 10$

28. $x^2 - 3x - 28$

29. $m^2 - 4m - 21$

30. $x^2 - 2x - 15$

31. $x^2 - 5x - 24$

32. $b^2 - 4b - 60$

33. $x^2 - 3x - 18$

34. $m^2 + 7m + 10$

35. $n^2 - n - 72$

36. $k^2 - 6k + 5$

37. $x^2 + 9x + 20$

38. $x^2 - 10x + 9$

39. $x^2 - 8x + 16$

40. $d^2 - 4d + 3$

41. $b^2 - 26b + 48$

42. $n^2 - 15n + 26$

43. $n^2 - n - 6$

44. $z^2 - 14z + 49$

45. $x^2 + 7x + 12$

46. $x^2 - 18x + 17$

47. $x^2 + 16x + 28$

48. $t^2 - 6t - 27$

49. $b^2 + 4b - 12$

50. $d^2 + 11d + 18$

51. $x^2 + x - 20$

52. $x^2 - 13x + 42$

53. $x^2 + x - 6$

54. $x^2 + 4x - 21$

55. $a^2 + 2a - 35$

56. $h^2 + 7h - 18$

57. $x^2 + 3x - 10$

58. $p^2 - 12p - 28$

59. $y^2 + 6y - 55$

60. $b^2 + 3b - 4$

61. $x^2 + 2x - 63$

62. $x^2 - 2x - 8$

63. $x^2 - 11x - 60$

64. $r^2 + 2r - 35$

65. $c^2 - 3c - 10$

66. $x^2 + 8x + 15$

67. $x^2 - 8x + 15$

68. $n^2 - 23n + 60$

69. $c^2 + 3c - 10$

70. $x^2 - 9x + 14$

71. $x^2 - 10x + 24$

72. $x^2 + 6x - 27$

73. $y^2 - 16y + 64$

74. $n^2 + 10n + 25$

75. $r^2 - 14r - 51$

76. $x^2 + 3x - 40$

77. $x^2 - x - 42$

78. $n^2 - 2n - 63$

79. $a^2 + 7a + 6$

80. $x^2 - 14x + 48$

81. $x^2 - 11x + 28$

82. $n^2 + 16n - 36$

83. $n^2 - 4n - 21$

84. $y^2 + 16y - 17$

Practice 9-6

Factor each expression.

1. $2x^2 + 3x + 1$

2. $2x^2 + 5x + 3$

3. $2n^2 + n - 6$

4. $3x^2 - x - 4$

5. $2y^2 - 9y - 5$

6. $5x^2 - 2x - 7$

7. $7n^2 + 9n + 2$

8. $3c^2 - 17c - 6$

9. $3x^2 + 8x + 4$

10. $6x^2 - 7x - 10$

11. $3x^2 - 10x + 8$

12. $3y^2 - 16y - 12$

13. $5x^2 + 2x - 3$

14. $3x^2 + 7x + 2$

15. $7x^2 - 10x + 3$

16. $3x^2 + 8x + 5$

17. $2x^2 + 9x + 4$

18. $5x^2 - 7x + 2$

19. $5x^2 - 22x + 8$

20. $4x^2 + 17x - 15$

21. $5x^2 - 33x - 14$

22. $3x^2 - 2x - 8$

23. $3y^2 + 7y - 6$

24. $2x^2 + 13x - 24$

25. $4y^2 - 11y - 3$

26. $2y^2 + 9y + 7$

27. $5y^2 - 3y - 2$

28. $7y^2 + 19y + 10$

29. $7x^2 - 30x + 8$

30. $3x^2 + 17x + 10$

31. $2x^2 + 5x - 3$

32. $2x^2 - 5x + 3$

33. $3x^2 + 10x + 3$

34. $2x^2 - x - 21$

35. $5x^2 - 11x + 2$

36. $4x^2 + 4x - 15$

37. $6x^2 - 19x + 15$

38. $2x^2 - x - 15$

39. $3x^2 - 7x - 6$

40. $2x^2 - 5x - 12$

41. $6x^2 - 7x - 5$

42. $4x^2 + 7x + 3$

43. $12y^2 - 7y + 1$

44. $6y^2 - 5y + 1$

45. $6x^2 - 11x + 4$

46. $12x^2 + 19x + 5$

47. $7y^2 + 47y - 14$

48. $11x^2 - 54x - 5$

49. $15x^2 - 19x + 6$

50. $8x^2 - 30x + 25$

51. $14y^2 + 15y - 9$

52. $22x^2 + 51x - 10$

53. $14x^2 - 41x + 15$

54. $8y^2 + 17y + 9$

55. $8x^2 + 65x + 8$

56. $20x^2 + 37x + 15$

57. $24y^2 + 41y + 12$

58. $18x^2 - 27x + 4$

59. $10x^2 + 3x - 4$

60. $10y^2 - 29y + 10$

Practice 9-7

Factor each expression.

1. $x^2 - 9$

2. $4m^2 - 1$

3. $a^2 + 2a + 1$

4. $4x^2 + 12x + 9$

5. $x^2 - 22x + 121$

6. $n^2 - 4$

7. $9x^2 - 4$

8. $16c^2 - 49$

9. $9x^2 - 30x + 25$

10. $4x^2 - 20x + 25$

11. $2a^2 - 18$

12. $x^2 - 24x + 144$

13. $3n^2 - 3$

14. $9h^2 + 60h + 100$

15. $9d^2 - 49$

16. $81a^2 - 400$

17. $r^2 - 36$

18. $3a^2 - 48$

19. $b^2 + 4b + 4$

20. $10x^2 - 90$

21. $25x^2 - 64$

22. $12w^2 - 27$

23. $g^3 - 25g$

24. $x^2 + 6x + 9$

25. $a^2 - 25$

26. $36s^2 - 225$

27. $4b^2 + 44b + 121$

28. $x^2 - 16x + 64$

29. $x^2 - 2x + 1$

30. $d^2 - 49$

31. $x^3 - 36x$

32. $9y^2 - 289$

33. $x^2 - 30x + 225$

34. $100a^2 - 9$

35. $2x^2 + 4x + 2$

36. $5n^3 - 20n$

37. $9n^2 + 12n + 4$

38. $d^2 - 169$

39. $4a^2 - 81$

40. $x^2 - 121$

41. $5x^2 + 40x + 80$

42. $16n^2 + 56n + 49$

43. $3n^2 - 30n + 75$

44. $a^2 + 26a + 169$

45. $25x^2 - 144$

46. $9d^2 - 64$

47. $n^2 - 28n + 196$

48. $49a^2 - 14a + 1$

49. $y^2 + 8y + 16$

50. $y^2 - 400$

51. $x^2 - 10x + 25$

52. $4x^2 - 60x + 225$

53. $3x^2 - 363$

54. $y^2 - 81$

55. $a^2 - 100$

56. $256a^2 - 1$

57. $n^2 + 34n + 289$

58. $2d^3 - 50d$

59. $y^2 + 22y + 121$

60. $144x^2 - 25$

61. $4x^2 - 169$

62. $x^2 - 12x + 36$

63. $64r^2 + 80r + 25$

64. $50m^3 - 32m$

65. $b^2 - 225$

66. $x^2 - 18x + 81$

67. $b^2 - 64$

68. $16x^2 - 72x + 81$

69. $b^2 - 256$

70. $x^2 + 24x + 144$

71. $225x^2 - 16$

72. $2x^3 + 40x^2 + 200x$

73. $4r^2 - 25$

74. $16x^2 + 8x + 1$

75. $b^2 - 14b + 49$

76. $x^2 + 30x + 225$

77. $m^2 - 28m + 196$

78. $9r^2 - 256$

79. $b^2 + 20b + 100$

80. $m^2 - 16$

81. $4x^2 - 32x + 64$

82. $x^2 - 196$

83. $8x^3 - 32x$

84. $25x^2 - 30x + 9$

85. $8m^2 - 16m + 8$

86. $9x^2 - 400$

87. $m^2 - 144$

Practice 9-8

Factor each expression.

1. $x(a + 2) - 2(a + 2)$

2. $3(x + y) + a(x + y)$

3. $m(x - 3) + k(x - 3)$

4. $a(y + 1) - b(y + 1)$

5. $x^2 + 3x + 2xy + 6y$

6. $y^2 - 5wy + 4y - 20w$

7. $xy + 4y - 2x - 8$

8. $ab + 7b - 3a - 21$

9. $ax + bx + ay + by$

10. $ax + bx - ay - by$

11. $2x^2 - 6xy + 5x - 15y$

12. $3x^2 - 6xy + 2x - 4y$

13. $2ax + 6xc + ba + 3bc$

14. $x^2y - 3x^2 - 2y + 6$

15. $6 + 2y + 3x^2 + x^2y$

16. $2x^2 - 3x + 1$

17. $2x^2 - 7x + 3$

18. $6x^2 + 7x + 2$

19. $4x^2 + 8x + 3$

20. $6x^2 - 7x + 2$

21. $4x^2 - 9x + 2$

22. $2x^2 - 3x - 2$

23. $12x^2 - x - 1$

24. $6x^2 + 19x + 3$

25. $12y^2 - 5y - 2$

26. $10y^2 + 21y - 10$

27. $5y^2 + 13y + 6$

28. $16y^2 + 10y + 1$

29. $16x^2 - 14x + 3$

30. $16x^2 + 16x + 3$

31. $10x^2 - 3x - 1$

32. $9x^2 + 25x - 6$

33. $14x^2 + 15x - 9$

34. $2x^3 + 8x^2 + x + 4$

35. $8x^4 + 6x - 28x^3 - 21$

36. $5x^3 - x^2 + 15x - 3$

37. $x^3 + 3x^2 + 4x + 12$

38. $6x^3 + 3x^2 + 2x + 1$

39. $3x^3 + 9x^2 + 2x + 6$

40. $9x^3 - 12x^2 + 3x - 4$

41. $10x^3 - 25x^2 + 4x - 10$

42. $4x^3 - 20x^2 + 3x - 15$

Find expressions for the possible dimensions of each rectangular prism.

43. The volume of the prism is given.

$144x^3 - 258x^2 + 105x$

44. The volume of the prism is given.

$28x^3 + 212x^2 + 112x$
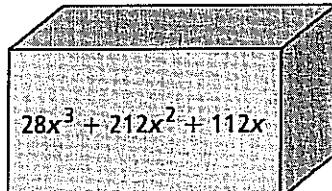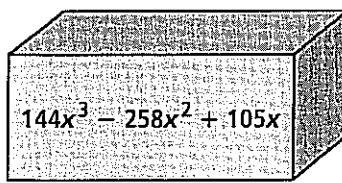
Reteaching 9-1

Adding and Subtracting Polynomials

OBJECTIVE: Adding and subtracting polynomials	MATERIALS: Tiles

Example

Using tiles, simplify $(2a^2 + 4a - 6) + (a^2 - 2a + 4)$.

← Use tiles to represent the terms of $2a^2 + 4a - 6$.

← Use tiles to represent the terms of $a^2 - 2a + 4$. Align like terms vertically with the tiles in the row above.

← Remove zero pairs.

← Count the remaining tiles.

$3a^2 + 2a - 2$

← Solution
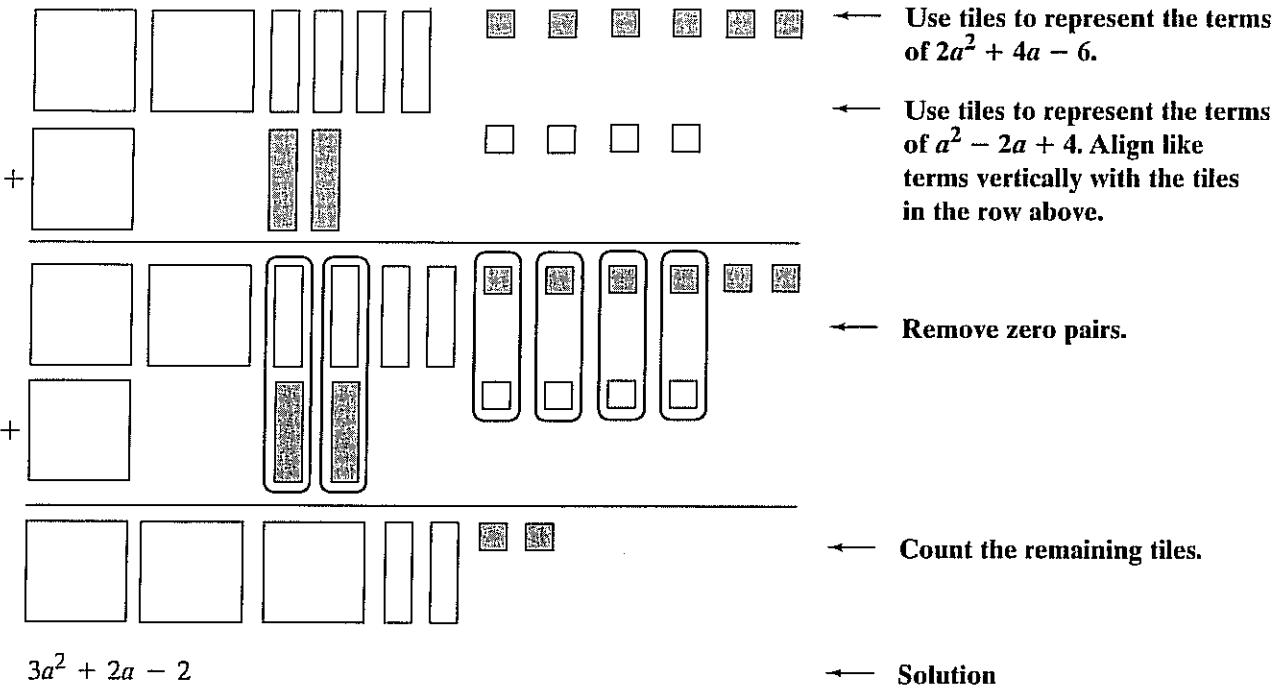
Exercises

Use tiles to simplify each sum or difference.

1. $(4x - 5y + 3) + (2x + 7y - 7)$

2. $(3a^2 + 5a - 6) - (2a^2 - 3a - 9)$

3. $(6x^2 - 3x + 2) + (3x^2 + x - 5)$

4. $(4x^2 + 2x - 7) - (-3x^2 - 6x + 2)$

5. $(6z^3 - 5z^2 + 1) + (8z^3 + 7z^2 - 4)$

6. $(4x^2 + 2) - (-2x^2 + 5) + (x^2 + 4)$

Simplify. Write each answer in standard form.

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

8. $(7x^3 - 3x + 1) - (x^3 + x^2 - 2)$

9. $(3y^2 - 3y + 2) + (4y^2 + 3y - 1)$

10. $(5x^2 - 10) - (3x^2 + 7)$

11. $(2x^3 + x^2 + 1) + (3x^3 - x^2 + 2)$

12. $(4x^3 + 3x + 2) - (2x^2 - 3x + 7)$

13. $(3x^2 + 7x - 6) + (x^3 + x^2 - x - 1)$

14. $(4x^2 - x + 6) - (3x^2 - 4)$

Reteaching 9-2

Multiplying and Factoring

OBJECTIVE: Factoring a monomial from a polynomial

MATERIALS: None

- To factor a polynomial you must find the **Greatest Common Factor**.
  The **GCF** is the greatest factor that divides evenly into each term.

Example

Factor $18x^3 + 6x^2 - 12x$.

a. First find the GCF.

$$18x^3 = \textcircled{2} \quad \textcircled{3} \quad 3 \quad \textcircled{x} \quad x \quad x$$

$$6x^2 = \textcircled{2} \quad \textcircled{3} \quad x \quad \textcircled{x}$$

$$12x = \quad \textcircled{2} \quad 2 \quad \textcircled{3} \quad \textcircled{x}$$

— **List the factors of each term. Circle the factors common to all terms.**

$$2 \cdot 3 \cdot x = 6x$$

— **Multiply the circled terms together to get the GCF.**

b. Factor out the GCF from each term.

$$\frac{18x^3}{6x} = 3x^2$$

— **Divide each term by the GCF.**

$$\frac{6x^2}{6x} = x$$

$$\frac{-12x}{6x} = -2$$

$$6x(3x^2 + x - 2)$$

— **Solution**

Exercises

Use the GCF to factor each polynomial.

1. $21x - 14$

2. $5y^3 - 10y^2 + 15y$

3. $x^3 + 3x^2 + x$

4. $3x^2 + 6x^4$

5. $18x^3 - 6x^2 + 24x$

6. $z^3 - 3z^2$

7. $12k^3 + 6k^2 - 18k$

8. $6x^3 - 4x^2 + 8x$

9. $8p^4 + 12p^2 + 4p$

10. $36x^2 - 18x$

11. $6x^2 + 18x$

12. $6x^3 - 2x^2 + 8x$

13. $6x^3 + 6x^2 - 6x$

14. $5x^3 + 5x^2$

15. $3x^2 + 6x + 3$

16. $10x^2 + 35x$

17. $8x^5 + 16x^4 - 8x^3$

18. $9x^3 - 6x^2 - 15x$

Reteaching 9-3

Multiplying Binomials

. . . .

OBJECTIVE: Multiplying binomials	**MATERIALS:** None

To multiply two binomials, follow these steps:

• Multiply each term in one binomial by each term of the other binomial. Drawing arrows as a visual reminder of what to do is a helpful technique.

• Circle like terms and combine.

Example

Find the product $(x + 7)(x + 2)$.

$(x + 7)(x + 2)$ ⟵ **Draw arrows from the first term in the first binomial to both terms in the second binomial.**

$x^2 + 2x$ ⟵ **Multiply each term of the second binomial by x.**

$(x + 7)(x + 2)$ ⟵ **Draw arrows from the second term in the first binomial to both terms in the second binomial.**

$7x + 14$ ⟵ **Multiply each term of the second binomial by 7.**

$x^2 + 2x + 7x + 14$ ⟵ **Add the two expressions.**

$x^2 + \boxed{2x} + \boxed{7x} + 14$ ⟵ **Circle like terms and combine.**

$x^2 + 9x + 14$ ⟵ **Solution**

Exercises

Use arrows as shown above to simplify each product.

1. $(x + 6)(x - 2)$　　**2.** $(x - 8)(x - 4)$　　**3.** $(x - 3)(x + 9)$

4. $(x + 2)(x - 7)$　　**5.** $(2x + 3)(x + 4)$　　**6.** $(x + 4)(2x + 5)$

Simplify each product.

7. $(7x + 4)(2x - 4)$　　**8.** $(3x + 2)(3x + 2)$　　**9.** $(5x + 1)(x + 1)$

10. $(2x + 1)(x + 1)$　　**11.** $(4x + 1)(2x - 1)$　　**12.** $(3x - 1)(x + 2)$

Reteaching 9-4

OBJECTIVE: Finding the square of a binomial and finding the difference of two squares.

MATERIALS: None

Examples

Finding the square of a binomial.

Remember:
- Square the first term.
- Double the product of the two terms.
- Square the last term.
- Write the sum of your three products.

$(x - 5)^2$

Square the first term:	x^2
Double $(x)(-5)$:	$2 \cdot (-5x) = -10x$
Square the last term:	$(-5)^2 = 25$
Write the sum of your three products:	$x^2 - 10x + 25$

Finding the difference of two squares.

Remember:
- Square the first term.
- Square the last term.
- Write the difference of your first square and your second square.

$(3x - 2)(3x + 2)$

Square the first term:	$(3x)^2 = 9x^2$
Square the last term:	$(2)^2 = 4$
Write the difference of your first square and your second square:	$9x^2 - 4$

Exercises

Find each product.

1. $(x - 7)^2$

2. $(x + 1)^2$

3. $(x - 4)^2$

4. $(x - y)^2$

5. $(2x + 3)^2$

6. $(3x - 5)^2$

7. $(2x + 1)^2$

8. $(5x - 4)^2$

9. $(x + 7)(x - 7)$

10. $(x + 8)(x - 8)$

11. $(x - 3)(x + 3)$

12. $(x + y)(x - y)$

13. $(4x + 3)(4x - 3)$

14. $(2x + 5)(2x - 5)$

15. $(3x + 2)(3x - 2)$

16. $(7x - 1)(7x + 1)$

Reteaching 9-5

Factoring Trinomials of the Type $x^2 + bx + c$

OBJECTIVE: Factoring trinomials of the type $x^2 + bx + c$	**MATERIALS:** Tiles

Examples

Factor $x^2 + 6x + 8$.

$$(x \quad)(x \quad)$$

⟵ Write factors of x^2, the first term of the trinomial, at the beginning of each set of parentheses. Note that the coefficient of x^2 is 1.

$+1$ and $+8$ -1 and -8

(+2) and (+4) -2 and -4

$(x + 2)(x + 4)$

⟵ List pairs of numbers that are factors of $+8$, which is the constant term of the trinomial. Choose the pair of factors that add to equal $+6$, the coefficient of the middle term of the trinomial.

⟵ Write those two factors, with their signs, at the end of each set of parentheses.
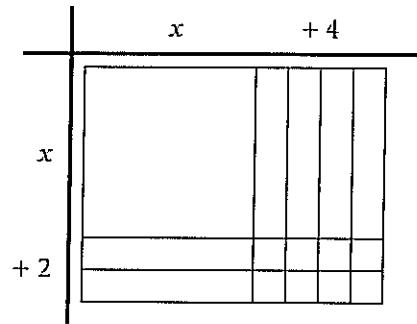
⟵ The trinomial $x^2 + 6x + 8$ represents the area of a rectangle with side of length $(x + 4)$ and $(x + 2)$.

Factor $x^2 + 4x - 21$.

$$(x \quad)(x \quad)$$

-1 and $+21$ $+1$ and -21

-3 and $+7$ $+3$ and -7

$(x - 3)(x + 7)$

⟵ List pairs of numbers that are factors of -21.

⟵ Choose the pair of factors that add to equal $+4$.

Exercises

Factor each expression.

1. $y^2 + 11y + 18$ **2.** $x^2 - 8x + 15$ **3.** $x^2 - 11x + 18$

4. $y^2 - 5y + 4$ **5.** $x^2 + 6x + 8$ **6.** $y^2 - 8y + 12$

7. $r^2 + 13r + 12$ **8.** $x^2 - 16x + 39$ **9.** $x^2 - 10x + 16$

10. $x^2 - x - 2$ **11.** $x^2 - 4x - 32$ **12.** $x^2 - 7x - 18$

13. $x^2 + 7x + 10$ **14.** $x^2 - 11x + 24$ **15.** $x^2 + 16x + 63$

Reteaching 9-6

Factoring Trinomials of the Type $ax^2 + bx + c$

OBJECTIVE: Factoring trinomials of the type $ax^2 + bx + c$; $a > 1$

MATERIALS: None

A table can be helpful when factoring trinomials of the type $ax^2 + bx + c$.

Examples

Factor $2x^2 + 13x + 20$.

Write the first term in the top left box of the table.

$\longrightarrow$
$2x^2$	

Write the constant term in the bottom right box of the table.

$\longrightarrow$
	20

Find the product ac.

$\longrightarrow$ Since $a = 2$ and $c = 20$, $ac = 40$.

Find two numbers whose product is ac and sum is b.

$\longrightarrow$ Since $ac = 40$ and $b = 13$, the numbers are 8 and 5.

These numbers are the coefficients of the x terms that are written in the remaining boxes of the table.

$\longrightarrow$
$2x^2$	$8x$
$5x$	20

(Note: Try repeating these steps, exchanging the locations of $5x$ and $8x$.)

Now, find the greatest common factors of the terms in each row and column. Write these above and to the left of the table.

$\longrightarrow$

	x	4
$2x$	$2x^2$	$8x$
5	$5x$	20

Read across the top of the table to find one factor.

$\longrightarrow$ $x + 4$

Read down the left of the table to find the other factor.

$\longrightarrow$ $2x + 5$

So, $2x^2 + 13x + 20 = (x + 4)(2x + 5)$.

You can check your answer using FOIL.

Factor $3x^2 - 2x - 8$.

$$ac = 3(-8) = -24$$
$$b = -2$$

The numbers whose product is -24 and sum is -2 are -6 and 4. Write $-6x$ and $4x$ in the table and find the GCFs of each row and column.

	$3x$	4
x	$3x^2$	$4x$
-2	$-6x$	-8

$3x^2 - 2x - 8 = (3x + 4)(x - 2)$.

Exercises

Factor each expression.

1. $2x^2 + 11x + 14$

2. $4x^2 - 12x + 5$

3. $6x^2 - 13x + 2$

4. $6x^2 + 7x - 20$

5. $3x^2 + 4x - 4$

6. $8x^2 - 13x - 6$

7. $2x^2 - 5x + 3$

8. $5x^2 - 26x - 24$

9. $6x^2 - 7x - 3$

10. $6x^2 + 7x - 3$

Reteaching 9-7

Factoring Special Cases

OBJECTIVE: Factoring the difference of two squares

MATERIALS: None

- The difference of two squares is written $a^2 - b^2$. Note that both terms must be perfect squares.

- The **factors** of the difference of two squares, $a^2 - b^2$ are $(a + b)$ and $(a - b)$. Once you have determined that the binomial you want to factor is the difference of two squares, you can factor by using the formula $a^2 - b^2 = (a + b)(a - b)$.

Examples

Factor $a^2 - 16$.

$a^2 - 16$ ⟵ **Both terms are perfect squares.**

$a^2 - 4^2$ ⟵ **Rewrite 16 as 4^2.**

$a^2 - b^2 = (a + b)(a - b)$ ⟵ **Write the formula.**

$a^2 - 4^2 = (a + 4)(a - 4)$ ⟵ **Replace b with 4.**

$(a + 4)(a - 4)$ ⟵ **Solution**

Factor $3a^2 - 75$.

$3a^2 - 75$ ⟵ **Both terms are *not* perfect squares.**

$3(a^2 - 25)$ ⟵ **Both $3a^2$ and 75 are divisible by 3. Factor out 3.**

$3(a^2 - 5^2)$ ⟵ **25 is a perfect square. Rewrite 25 as 5^2.**

$a^2 - b^2 = (a + b)(a - b)$ ⟵ **Write the formula.**

$3(a^2 - 5^2) = 3(a + 5)(a - 5)$ ⟵ **Replace b with 5.**

$3(a + 5)(a - 5)$ ⟵ **Solution**

Exercises

Factor each expression.

1. $a^2 - 36$ **2.** $x^2 - 64$ **3.** $y^2 - 49$

4. $4x^2 - 25$ **5.** $9y^2 - 16$ **6.** $25x^2 - 64$

7. $3x^2 - 12$ **8.** $2x^2 - 18$ **9.** $4x^2 - 16$

10. $x^2 - 225$ **11.** $x^2 - 144$ **12.** $16x^2 - 49$

13. $6x^2 - 54$ **14.** $7x^2 - 112$ **15.** $5x^2 - 125$

Reteaching 9-8

Factoring by Grouping

•••

OBJECTIVE: Factoring by grouping	**MATERIALS:** None

To factor a polynomial with four terms, we can sometimes group pairs of terms together, find the GCF of each pair, then factor a GCF from the resulting terms.

Examples

Factor $2x^3 - 8x^2 + 5x - 20$.

Group pairs of terms together.   ⟶ $(2x^3 - 8x^2) + (5x - 20)$

Factor the GCF from each pair.   ⟶ $2x^2(x - 4) + 5(x - 4)$

(Note: To proceed with this method, both sets of parentheses must contain the same expression.)

Replace the expressions in parentheses with ▲.   ⟶ $2x^2 ▲ + 5 ▲$

Now, factor the common factor ▲ from both terms.   ⟶ $▲ (2x^2 + 5)$

Lastly, replace the ▲ with the expression it represents.   ⟶ $(x - 4)(2x^2 + 5)$

So, $2x^3 - 8x^2 + 5x - 20 = (x - 4)(2x^2 + 5)$.

You can check your answer using FOIL.

It is sometimes possible to use this method to factor trinomials by first rewriting the middle term as a sum.

Factor $2x^2 + 13x + 15$.

Find two numbers whose product is ac and sum is b.   ⟶ Since $a = 2$ and $c = 15$, $ac = 30$. Since $ac = 30$ and $b = 13$, the numbers are 10 and 13.

Rewrite the middle term as a sum of two terms whose coefficients are the two numbers you just found.   ⟶ $13x = 10x + 3x$

Replace the middle term with this sum.   ⟶ $2x^2 + (10x + 3x) + 15$

Regroup the terms and proceed as in the first Example.   ⟶ $(2x^2 + 10x) + (3x + 15)$

Factor the GCF from each pair.   ⟶ $2x(x + 5) + 3(x + 5)$

Replace the common expression with ▲.   ⟶ $2x ▲ + 3 ▲$

Factor ▲ from both terms.   ⟶ $▲(2x + 3)$

Replace the ▲ with the expression.   ⟶ $(x + 5)(2x + 3)$

So, $2x^2 + 13x + 15 = (x + 5)(2x + 3)$.

Exercises

Factor each polynomial by grouping.

1. $2x^3 + 4x^2 + x + 2$ **2.** $2x^3 + 6x^2 + 3x + 9$ **3.** $5x^3 - 25x^2 + 2x - 10$

4. $2x^3 + 12x^2 - 5x - 30$ **5.** $7x^3 - 4x^2 + 7x - 4$ **6.** $9x^3 - 12x^2 - 18x + 24$

7. $3x^2 + x - 2$ **8.** $2x^2 - x - 3$ **9.** $5x^2 + 34x - 7$

•••

Enrichment 9-1

Math Magic

1. A magic square is shown. Add the numbers in each row, in each column, and in each diagonal. What "magical" property do you observe?

7	2	16	9
12	13	3	6
1	8	10	15
14	11	5	4

2. Add the constant 3 to each entry of the magic square. Is the new square a magic square?

3. Subtract the constant 7 from each entry. Is the new square a magic square?

4. Complete the 5 × 5 array at the right so that it becomes a magic square.

17		1	8	
	5	7		16
4		13	20	
10	12		21	3
11	18			9

5. Add the polynomials in each row, column, and diagonal. What is each sum?

6. Is it a magic square?

$x - 4$	$x + 1$	x
$x + 3$	$x - 1$	$x - 5$
$x - 2$	$x - 3$	$x + 2$

7. Complete the 4 × 4 array so that it becomes a magic square.

$x + 10$	$x - 3$	$x - 4$	$x + 7$
$x - 1$	$x + 4$	$x + 5$	
	x		$x + 6$
$x - 2$		$x + 8$	

Chapter 9 Answers

Practice 9-1

1. $4y^3 - 4y^2 - y + 3$; cubic polynomial with four terms
2. $x^4 + x^2 - 6$; fourth degree trinomial **3.** $x + 2$; linear binomial **4.** $-7m^3 + 2m^2 + 3m$; cubic trinomial
5. $2x^2 - x + 4$; quadratic trinomial **6.** $7x^3 + 2x^2$; cubic binomial **7.** $n^2 - 5n$; quadratic binomial
8. $7x^2 + 6$; quadratic binomial **9.** $a^3 + 3a^2 - 4a + 3$; cubic polynomial with four terms **10.** $3x + 5$; linear binomial
11. $-8a^2 + 6a + 7$; quadratic trinomial **12.** $-x^2 + 5x + 4$; quadratic trinomial **13.** $-x^3 + 4x^2 + 2$; cubic trinomial
14. $4x^3 - 2x^2$; cubic binomial **15.** $y^2 - 3y - 7$; quadratic trinomial **16.** $-6x^2 + x - 3$; quadratic trinomial
17. $v^3 + 2v^2 - v$; cubic trinomial **18.** $3d^2 + 8d$; quadratic binomial **19.** $2x^2 - 9x - 3$ **20.** $3x^3 - 7x^2 + 4$
21. $-2y^3 - y^2 - 11y + 1$ **22.** $2x^3 - 7x + 1$
23. $3a^3 + 4a^2 + 5a$ **24.** $2y^3 - 4y + 10$ **25.** $6x^2 + x - 9$
26. $3n^2 - n - 4$ **27.** $4n^3 - n^2 + 4$ **28.** $7y^2 - 12y$
29. $3x^2 + 3x - 20$ **30.** $x^3 - 5x^2 + x$ **31.** $-2x^3 - x^2 - 2x$
32. $2d^3 - 4d^2 - 6d + 5$ **33.** $x^3 + 8x^2$ **34.** $3c^2 - 3c - 3$
35. $4y^2 - 11y$ **36.** $2c^2 - 3$ **37.** $16x^2 + 14x + 15$
38. $-15x^2 - 6x + 3$ **39.** $3x^2 + 7x + 16$
40. $7x^3 - 11x^2 - x + 3$ **41.** $y^3 - 5y^2 + y - 2$
42. $-x^3 - 7x^2 - 8x + 5$ **43.** $2x^2 - x + 2$
44. $-2x^2 - 8x + 1$ **45.** $-2x^3 + 11x^2 + x - 5$
46. $a^3 + 5a^2 + 3a$ **47.** $4x + 1$ **48.** $3n + 4$
49. $x^3 - x^2 + 7x - 6$ **50.** $6s^2 + 7s + 4$
51. $5x^2 - 6x + 14$ **52.** $5x^3 - x^2 - 3x + 13$ **53.** -6
54. $x^3 - 2x^2 + x + 3$ **55.** $4x^2 + 20$
56. $x^3 - 8x^2 - x + 12$ **57.** $2x + 9$ **58.** $2x^2 - 3x + 8$

Practice 9-2

1. $4a - 12$ **2.** $-5x + 10$ **3.** $-3x^4 - 9x^3$ **4.** $4x^4 - 12x^3$
5. $-5x^4 - 10x^3 - 5x^2$ **6.** $3x^3 - 15x^2 - 9x$
7. $2x^4 - 3x^3 + 2x^2$ **8.** $4d^4 - 12d^3 - 28d^2$
9. $5m^4 + 30m^3$ **10.** $2a^3 + 4a^2$ **11.** $5x^2 + x - 12$
12. $20x^2 - 24x$ **13.** 4 **14.** $15x$ **15.** x **16.** 4 **17.** 12
18. $4n^2$ **19.** $7x^2$ **20.** $4x$ **21.** 9 **22.** $5x^2$ **23.** $11x$ **24.** $2n^2$
25. $4d$ **26.** 3 **27.** 8 **28.** $2(4x + 5)$ **29.** $4n(3n^2 - 2)$
30. $2(7d - 1)$ **31.** $2h(3h - 4)$ **32.** $3z^2(z^2 - 5z - 3)$
33. $y(3y^2 - 8y - 9)$ **34.** $x^2(x - 5)$ **35.** $4x(2x^2 - 3x + 1)$
36. $7x^3(3x + 1)$ **37.** $2a(3a^2 - 6a + 7)$ **38.** $6x^2(x^2 + 2)$
39. $3n(n^3 - 2n + 3)$ **40.** $2w(w^2 + 3w - 2)$
41. $6c^2(2c - 5)$ **42.** $2(x^2 + 4x - 7)$ **43.** $4x(x^2 + 3x + 4)$
44. $4m(4m^2 - 2m + 3)$ **45.** $4a(a^2 - 5a - 2)$
46. $c(18c^3 - 9c + 7)$ **47.** $3y^2(2y^2 + 3y - 9)$ **48.** $3c(2c - 1)$
49. $x^2(4 - \pi)$ **50.** $5x^2$ **51.** $x^2(36\pi - 1)$

Practice 9-3

1. $2x^2 + x - 15$ **2.** $x^3 + 2x^2 - 1$ **3.** $12w^2 + 5w - 4$
4. $x^2 + 9x + 20$ **5.** $2b^3 - 7b^2 + 11b - 4$ **6.** $a^2 - 6a - 55$
7. $4g^3 - 4g^2 - 11g + 12$ **8.** $3s^2 - 19s + 20$
9. $4x^2 - 25x - 21$ **10.** $x^3 + 2x^2 - 21x + 18$
11. $20x^2 - 2x - 6$ **12.** $12y^2 + 43y + 35$
13. $3x^2 + 22x + 35$ **14.** $5x^2 + 13x - 6$
15. $3m^3 - 13m^2 + 22m - 16$ **16.** $a^2 + 2a - 48$
17. $2x^3 + x^2 - 4x + 4$ **18.** $a^3 - 1$

19. $x^3 + 2x^2 - 4x - 8$ **20.** $6r^2 + r - 1$ **21.** $3k^2 + 8k - 16$
22. $2n^3 - 7n^2 + 16n - 15$ **23.** $2p^2 - 5p - 12$
24. $12x^3 - 2x^2 + x + 1$ **25.** $8x^3 - 26x^2 + 23x - 6$
26. $x^2 + 12x + 35$ **27.** $6x^2 + x - 22$ **28.** $8x^2 + 10x + 3$
29. $9x^2 - 16$ **30.** $18x^2 - 9x - 5$ **31.** $n^2 - 3n - 28$
32. $6x^2 + x - 1$ **33.** $d^2 - 2d - 99$
34. $4x^3 + 12x^2 - x - 3$ **35.** $2b^2 + 11b - 40$
36. $2x^2 + 3x - 20$ **37.** $15x^2 + 4x - 35$
38. $2x^3 - 17x^2 + 33x + 10$ **39.** $4x^3 - 16x^2 + 13x + 11$
40. $4x^3 + 24x^2 + 27x - 28$ **41.** $3x^3 + 23x^2 + 63x + 55$
42. $35x^2 + 64x + 21$ **43.** $8x^2 - 34x + 35$
44. $3x^2 - 22x - 45$ **45.** $2x^3 - 15x^2 + 9x - 1$
46a. $2x^2 + 18x + 40$ **46b.** 544 in.^{2} **46c.** 760 in.^{2}
47a. $3x^2 - 16x + 16$ **47b.** 156 ft^2 **47c.** 115 ft^2
48. 27 in. by 23 in.

Practice 9-4

1. $w^2 - 4w + 4$ **2.** $y^2 + 8y + 16$ **3.** $16w^2 + 16w + 4$
4. $w^2 - 18w + 81$ **5.** $9x^2 + 42x + 49$ **6.** $9x^2 - 42x + 49$
7. $4x^2 - 36x + 81$ **8.** $x^2 - 24x + 144$ **9.** $36x^2 + 12x + 1$
10. $16x^2 - 56x + 49$ **11.** $x^2 - 64$ **12.** $x^2 - 121$
13. $x^2 - 144$ **14.** $y^2 - w^2$ **15.** $4x^2 - 1$ **16.** $25x^2 - 4$
17. $36x^2 - 1$ **18.** $4x^2 - 16$ **19.** $x^4 + 2x^2y^2 + y^4$
20. $4x^4 + 4x^2y^2 + y^4$ **21.** $a^4 - 2a^2b^2 + b^4$
22. $y^4 - 8y^2w^2 + 16w^4$ **23.** $9 - 36x^2 + 36x^4$
24. $16a^2 - 24ay + 9y^2$ **25.** $9y^2 - 4a^2$ **26.** $x^4 - 4y^2$
27. $9x^4 - 16w^4$ **28.** $16x^2 - 9w^4$ **29.** $4a^2 - 49b^2$
30. $25a^4 - 36x^2$ **31.** 324 **32.** 4096 **33.** 899 **34.** 9991
35. 798 **36.** 19,475 **37.** $4x^2 + 4x + 1$ **38.** $9x^2 - 4$
39. $22x + 121$ **40.** $(18x + 81)\pi$

Practice 9-5

1. $(x + 4)(x + 4)$ **2.** $(d + 7)(d + 1)$
3. $(y + 4)(y + 2)$ **4.** $(b - 3)(b + 1)$
5. $(s - 5)(s + 1)$ **6.** $(x + 8)(x + 4)$
7. $(x - 4)(x - 5)$ **8.** $(x - 2)(x - 3)$
9. $(a + 2)(a + 1)$ **10.** $(p - 7)(p - 1)$
11. $(d + 1)(d + 5)$ **12.** $(n + 3)(n - 2)$
13. $(x + 7)(x - 2)$ **14.** $(b + 7)(b + 2)$
15. $(x + 9)(x + 5)$ **16.** $(a + 3)(a + 4)$
17. $(x + 2)(x + 11)$ **18.** $(x + 4)(x - 1)$
19. $(x - 6)(x - 2)$ **20.** $(x + 9)(x - 2)$
21. $(n - 5)(n - 2)$ **22.** $(s - 7)(s + 2)$
23. $(x - 8)(x - 1)$ **24.** $(x - 6)(x + 4)$
25. $(x - 9)(x + 3)$ **26.** $(x - 18)(x + 2)$
27. $(x + 5)(x + 2)$ **28.** $(x - 7)(x + 4)$
29. $(m - 7)(m + 3)$ **30.** $(x + 3)(x - 5)$
31. $(x - 8)(x + 3)$ **32.** $(b - 10)(b + 6)$
33. $(x - 6)(x + 3)$ **34.** $(m + 5)(m + 2)$
35. $(n - 9)(n + 8)$ **36.** $(k - 5)(k - 1)$
37. $(x + 4)(x + 5)$ **38.** $(x - 9)(x - 1)$
39. $(x - 4)(x - 4)$ **40.** $(d - 3)(d - 1)$
41. $(b - 24)(b - 2)$ **42.** $(n - 13)(n - 2)$
43. $(n - 3)(n + 2)$ **44.** $(z - 7)(z - 7)$
45. $(x + 4)(x + 3)$ **46.** $(x - 17)(x - 1)$
47. $(x + 14)(x + 2)$ **48.** $(t - 9)(t + 3)$

49. $(b + 6)(b - 2)$ **50.** $(d + 2)(d + 9)$
51. $(x + 5)(x - 4)$ **52.** $(x - 7)(x - 6)$
53. $(x + 3)(x - 2)$ **54.** $(x + 7)(x - 3)$
55. $(a - 5)(a + 7)$ **56.** $(h + 9)(h - 2)$
57. $(x + 5)(x - 2)$ **58.** $(p - 14)(p + 2)$
59. $(y + 11)(y - 5)$ **60.** $(b + 4)(b - 1)$
61. $(x + 9)(x - 7)$ **62.** $(x - 4)(x + 2)$
63. $(x - 15)(x + 4)$ **64.** $(r + 7)(r - 5)$
65. $(c - 5)(c + 2)$ **66.** $(x + 5)(x + 3)$
67. $(x - 5)(x - 3)$ **68.** $(n - 20)(n - 3)$
69. $(c + 5)(c - 2)$ **70.** $(x - 7)(x - 2)$
71. $(x - 6)(x - 4)$ **72.** $(x + 9)(x - 3)$
73. $(y - 8)(y - 8)$ **74.** $(n + 5)(n + 5)$
75. $(r - 17)(r + 3)$ **76.** $(x + 8)(x - 5)$
77. $(x - 7)(x + 6)$ **78.** $(n - 9)(n + 7)$
79. $(a + 6)(a + 1)$ **80.** $(x - 8)(x - 6)$
81. $(x - 7)(x - 4)$ **82.** $(n + 18)(n - 2)$
83. $(n - 7)(n + 3)$ **84.** $(y + 17)(y - 1)$

Practice 9-6

1. $(x + 1)(2x + 1)$ **2.** $(x + 1)(2x + 3)$
3. $(n + 2)(2n - 3)$ **4.** $(x + 1)(3x - 4)$
5. $(2y + 1)(y - 5)$ **6.** $(x + 1)(5x - 7)$
7. $(n + 1)(7n + 2)$ **8.** $(c - 6)(3c + 1)$
9. $(x + 2)(3x + 2)$ **10.** $(x - 2)(6x + 5)$
11. $(x - 2)(3x - 4)$ **12.** $(y - 6)(3y + 2)$
13. $(x + 1)(5x - 3)$ **14.** $(x + 2)(3x + 1)$
15. $(x - 1)(7x - 3)$ **16.** $(x + 1)(3x + 5)$
17. $(x + 4)(2x + 1)$ **18.** $(x - 1)(5x - 2)$
19. $(x - 4)(5x - 2)$ **20.** $(x + 5)(4x - 3)$
21. $(x - 7)(5x + 2)$ **22.** $(x - 2)(3x + 4)$
23. $(y + 3)(3y - 2)$ **24.** $(x + 8)(2x - 3)$
25. $(y - 3)(4y + 1)$ **26.** $(y + 1)(2y + 7)$
27. $(y - 1)(5y + 2)$ **28.** $(y + 2)(7y + 5)$
29. $(x - 4)(7x - 2)$ **30.** $(x + 5)(3x + 2)$
31. $(2x - 1)(x + 3)$ **32.** $(2x - 3)(x - 1)$
33. $(3x + 1)(x + 3)$ **34.** $(2x - 7)(x + 3)$
35. $(5x - 1)(x - 2)$ **36.** $(2x + 5)(2x - 3)$
37. $(3x - 5)(2x - 3)$ **38.** $(2x + 5)(x - 3)$
39. $(x - 3)(3x + 2)$ **40.** $(2x + 3)(x - 4)$
41. $(2x + 1)(3x - 5)$ **42.** $(4x + 3)(x + 1)$
43. $(3y - 1)(4y - 1)$ **44.** $(2y - 1)(3y - 1)$
45. $(2x - 1)(3x - 4)$ **46.** $(3x + 1)(4x + 5)$
47. $(y + 7)(7y - 2)$ **48.** $(x - 5)(11x + 1)$
49. $(3x - 2)(5x - 3)$ **50.** $(2x - 5)(4x - 5)$
51. $(2y + 3)(7y - 3)$ **52.** $(2x + 5)(11x - 2)$
53. $(2x - 5)(7x - 3)$ **54.** $(y + 1)(8y + 9)$
55. $(x + 8)(8x + 1)$ **56.** $(4x + 5)(5x + 3)$
57. $(3y + 4)(8y + 3)$ **58.** $(3x - 4)(6x - 1)$
59. $(2x - 1)(5x + 4)$ **60.** $(2y - 5)(5y - 2)$

Practice 9-7

1. $(x - 3)(x + 3)$ **2.** $(2m - 1)(2m + 1)$ **3.** $(a + 1)^2$
4. $(2x + 3)^2$ **5.** $(x - 11)^2$ **6.** $(n - 2)(n + 2)$
7. $(3x - 2)(3x + 2)$ **8.** $(4c - 7)(4c + 7)$
9. $(3x - 5)^2$ **10.** $(2x - 5)^2$ **11.** $2(a - 3)(a + 3)$
12. $(x - 12)^2$ **13.** $3(n - 1)(n + 1)$ **14.** $(3h + 10)^2$
15. $(3d - 7)(3d + 7)$ **16.** $(9a - 20)(9a + 20)$

17. $(r - 6)(r + 6)$ **18.** $3(a - 4)(a + 4)$ **19.** $(b + 2)^2$
20. $10(x - 3)(x + 3)$ **21.** $(5x - 8)(5x + 8)$
22. $3(2w - 3)(2w + 3)$ **23.** $g(g - 5)(g + 5)$
24. $(x + 3)^2$ **25.** $(a - 5)(a + 5)$ **26.** $9(2s - 5)(2s + 5)$
27. $(2b + 11)^2$ **28.** $(x - 8)^2$ **29.** $(x - 1)^2$ **30.** $(d - 7)(d + 7)$
31. $x(x - 6)(x + 6)$ **32.** $(3y - 17)(3y + 17)$
33. $(x - 15)^2$ **34.** $(10a - 3)(10a + 3)$ **35.** $2(x + 1)^2$
36. $5n(n + 2)(n - 2)$ **37.** $(3n + 2)^2$ **38.** $(d - 13)(d + 13)$
39. $(2a - 9)(2a + 9)$ **40.** $(x - 11)(x + 11)$ **41.** $5(x + 4)^2$
42. $(4n + 7)^2$ **43.** $3(n - 5)^2$ **44.** $(a + 13)^2$
45. $(5x - 12)(5x + 12)$ **46.** $(3d - 8)(3d + 8)$
47. $(n - 14)^2$ **48.** $(7a - 1)^2$ **49.** $(y + 4)^2$
50. $(y - 20)(y + 20)$ **51.** $(x - 5)^2$ **52.** $(2x - 15)^2$
53. $3(x - 11)(x + 11)$ **54.** $(y - 9)(y + 9)$
55. $(a - 10)(a + 10)$ **56.** $(16a - 1)(16a + 1)$
57. $(n + 17)^2$ **58.** $2d(d - 5)(d + 5)$ **59.** $(y + 11)^2$
60. $(12x - 5)(12x + 5)$ **61.** $(2x - 13)(2x + 13)$
62. $(x - 6)^2$ **63.** $(8r + 5)^2$ **64.** $2m(5m - 4)(5m + 4)$
65. $(b - 15)(b + 15)$ **66.** $(x - 9)^2$ **67.** $(b - 8)(b + 8)$
68. $(4x - 9)^2$ **69.** $(b - 16)(b + 16)$ **70.** $(x + 12)^2$
71. $(15x - 4)(15x + 4)$ **72.** $2x(x + 10)^2$
73. $(2r - 5)(2r + 5)$ **74.** $(4x + 1)^2$ **75.** $(b - 7)^2$
76. $(x + 15)^2$ **77.** $(m - 14)^2$ **78.** $(3r - 16)(3r + 16)$
79. $(b + 10)^2$ **80.** $(m - 4)(m + 4)$ **81.** $4(x - 4)^2$
82. $(x - 14)(x + 14)$ **83.** $8x(x - 2)(x + 2)$ **84.** $(5x - 3)^2$
85. $8(m - 1)^2$ **86.** $(3x - 20)(3x + 20)$
87. $(m - 12)(m + 12)$

Practice 9-8

1. $(x - 2)(a + 2)$ **2.** $(3 + a)(x + y)$ **3.** $(m + k)(x - 3)$
4. $(a - b)(y + 1)$ **5.** $(x + 2y)(x + 3)$ **6.** $(y + 4)(y - 5w)$
7. $(y - 2)(x + 4)$ **8.** $(b - 3)(a + 7)$ **9.** $(a + b)(x + y)$
10. $(a + b)(x - y)$ **11.** $(x - 3y)(2x + 5)$
12. $(x - 2y)(3x + 2)$ **13.** $(2x + b)(a + 3c)$
14. $(x^2 - 2)(y - 3)$ **15.** $(2 + x^2)(3 + y)$
16. $(2x - 1)(x - 1)$ **17.** $(2x - 1)(x - 3)$
18. $(3x + 2)(2x + 1)$ **19.** $(2x + 3)(2x + 1)$
20. $(3x - 2)(2x - 1)$ **21.** $(4x - 1)(x - 2)$
22. $(2x + 1)(x - 2)$ **23.** $(4x + 1)(3x - 1)$
24. $(6x + 1)(x + 3)$ **25.** $(3y - 2)(4y + 1)$
26. $(2y + 5)(5y - 2)$ **27.** $(5y + 3)(y + 2)$
28. $(8y + 1)(2y + 1)$ **29.** $(8x - 3)(2x - 1)$
30. $(4x + 1)(4x + 3)$ **31.** $(5x + 1)(2x - 1)$
32. $(9x - 2)(x + 3)$ **33.** $(7x - 3)(2x + 3)$
34. $(x + 4)(2x^2 + 1)$ **35.** $(4x^3 + 3)(2x - 7)$
36. $(x^2 + 3)(5x - 1)$ **37.** $(x + 3)(x^2 + 4)$
38. $(2x + 1)(3x^2 + 1)$ **39.** $(x + 3)(3x^2 + 2)$
40. $(3x - 4)(3x^2 + 1)$ **41.** $(2x - 5)(5x^2 + 2)$
42. $(x - 5)(4x^2 + 3)$ **43.** $3x(6x - 7)(8x - 5)$
44. $4x(x + 7)(7x + 4)$

Reteaching 9-1

1. $6x + 2y - 4$ **2.** $a^2 + 8a + 3$ **3.** $9x^2 - 2x - 3$
4. $7x^2 + 8x - 9$ **5.** $14z^3 + 2z^2 - 3$ **6.** $7x^2 + 1$
7. $5x^2 - x + 1$ **8.** $6x^3 - x^2 - 3x + 3$ **9.** $7y^2 + 1$
10. $2x^2 - 17$ **11.** $5x^3 + 3$ **12.** $4x^3 - 2x^2 + 6x - 5$
13. $x^3 + 4x^2 + 6x - 7$ **14.** $x^2 - x + 10$

Chapter 9 Answers (continued)

Reteaching 9-2

1. $7(3x - 2)$ **2.** $5y(y^2 - 2y + 3)$ **3.** $x(x^2 + 3x + 1)$
4. $3x^2(1 + 2x^2)$ **5.** $6x(3x^2 - x + 4)$ **6.** $z^2(z - 3)$
7. $6k(2k^2 + k - 3)$ **8.** $2x(3x^2 - 2x + 4)$
9. $4p(2p^3 + 3p + 1)$ **10.** $18x(2x - 1)$ **11.** $6x(x + 3)$
12. $2x(3x^2 - x + 4)$ **13.** $6x(x^2 + x - 1)$ **14.** $5x^2(x + 1)$
15. $3(x + 1)(x + 1)$ **16.** $5x(2x + 7)$ **17.** $8x^3(x^2 + 2x - 1)$
18. $3x(3x - 5)(x + 1)$

Reteaching 9-3

1. $x^2 + 4x - 12$ **2.** $x^2 - 12x + 32$ **3.** $x^2 + 6x - 27$
4. $x^2 - 5x - 14$ **5.** $2x^2 + 11x + 12$ **6.** $2x^2 + 13x + 20$
7. $14x^2 - 20x - 16$ **8.** $9x^2 + 12x + 4$ **9.** $5x^2 + 6x + 1$
10. $2x^2 + 3x + 1$ **11.** $8x^2 - 2x - 1$ **12.** $3x^2 + 5x - 2$

Reteaching 9-4

1. $x^2 - 14x + 49$ **2.** $x^2 + 2x + 1$ **3.** $x^2 - 8x + 16$
4. $x^2 - 2xy + y^2$ **5.** $4x^2 + 12x + 9$ **6.** $9x^2 - 30x + 25$
7. $4x^2 + 4x + 1$ **8.** $25x^2 - 40x + 16$ **9.** $x^2 - 49$
10. $x^2 - 64$ **11.** $x^2 - 9$ **12.** $x^2 - y^2$ **13.** $16x^2 - 9$
14. $4x^2 - 25$ **15.** $9x^2 - 4$ **16.** $49x^2 - 1$

Reteaching 9-5

1. $(y + 9)(y + 2)$ **2.** $(x - 3)(x - 5)$ **3.** $(x - 9)(x - 2)$
4. $(y - 1)(y - 4)$ **5.** $(x + 4)(x + 2)$
6. $(y - 6)(y - 2)$ **7.** $(r + 12)(r + 1)$
8. $(x - 3)(x - 13)$ **9.** $(x - 2)(x - 8)$
10. $(x - 2)(x + 1)$ **11.** $(x - 8)(x + 4)$
12. $(x - 9)(x + 2)$ **13.** $(x + 2)(x + 5)$
14. $(x - 3)(x - 8)$ **15.** $(x + 7)(x + 9)$

Reteaching 9-6

1. $(2x + 7)(x + 2)$ **2.** $(2x - 5)(2x - 1)$
3. $(x - 2)(6x - 1)$ **4.** $(3x - 4)(2x + 5)$
5. $(x + 2)(3x - 2)$ **6.** $(8x - 3)(x + 2)$
7. $(x - 1)(2x - 3)$ **8.** $(5x + 4)(x - 6)$
9. $(3x + 1)(2x - 3)$ **10.** $(2x + 3)(3x - 1)$
11. $(4x + 3)(2x - 1)$ **12.** $(3x - 1)(5x - 2)$

Reteaching 9-7

1. $(a + 2)(a - 1)$ **2.** $(x + 8)(x - 8)$
3. $(y + 7)(y - 7)$ **4.** $(2x + 5)(2x - 5)$
5. $(3y + 4)(3y - 4)$ **6.** $(5x + 8)(5x - 8)$
7. $3(x + 2)(x - 2)$ **8.** $2(x + 3)(x - 3)$
9. $4(x - 2)(x + 2)$ **10.** $(x + 15)(x - 15)$
11. $(x - 12)(x + 12)$ **12.** $(4x + 7)(4x - 7)$
13. $6(x - 3)(x + 3)$ **14.** $7(x - 4)(x + 4)$
15. $5(x - 5)(x + 5)$

Reteaching 9-8

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

Enrichment 9-1

1. All sums = 34.
2. yes;

10	5	19	12
15	16	6	9
4	11	13	18
17	14	8	7

3. yes;

0	−5	9	2
5	6	−4	−1
−6	1	3	8
7	4	−2	−3

4.

17	24	1	8	15
23	5	7	14	16
4	6	13	20	22
10	12	19	21	3
11	18	25	2	9

5. $3x - 3$ **6.** yes

7.

$x + 10$	$x - 3$	$x - 4$	$x + 7$
$x - 1$	$x + 4$	$x + 5$	$x + 2$
$x + 3$	x	$x + 1$	$x + 6$
$x - 2$	$x + 9$	$x + 8$	$x - 5$

Enrichment 9-2

1.

6	7	2
1	5	9
8	3	4

2. all sums equal 15
3. yes;

18	21	6
3	15	27
24	9	12

4.

$6x$	$7x$	$2x$
x	$5x$	$9x$
$8x$	$3x$	$4x$

5.

$12x + 6$	$14x + 7$	$4x + 2$
$2x + 1$	$10x + 5$	$18x + 9$
$16x + 8$	$6x + 3$	$8x + 4$

6. yes **7.** yes; sum $= 7\frac{1}{2}x + 3$ **8.** Check students' work.

Enrichment 9-3

1. 3819 **2.** 121,968 **3.** $x^2 + 6x + 8$