3.5 Exercises

[07-10-29-L10]

Factor out the greatest common factor. See Examples 1–6.

1. $15k + 30$
2. $7m - 21$
3. $6p^2 + 4p$
4. $12a^3 + 9a^2$
5. $8m^2p - 4mp^2$
6. $12z^2 - 6zw^3$
7. $5xy - 8xy^2$
8. $4ab + 2a^2b$
9. $8m^4 + 6m^3 - 4m^2$
10. $2p^5 + 4p^6 - 8p^3$
11. $10t^5 - 8t^4 - 16t^3$
12. $6p^3 - 18p^2 + 9p^4$
13. $6r^2s - 3rs^2 - 9r^3s$
14. $5p^3t^2 + 25p^2t^3 + 10p^3t^4$
15. $2x^2y - 3xy^2 + 4x^2y^2$
16. $14a^3b^2 + 7a^2b - 21a^5b^3$
17. $12km^3 - 24k^3m^2 + 36k^2m^4$
18. $15m^3p^3 - 6m^3p^4 + 9mp^3$
19. $144z^{11}m^4 + 16z^3m^5 - 32z^4m^5$
20. $39a^5b^3 - 26a^7b^2 + 52a^8b^5$
21. $16z^2n^6 + 64zn^7 - 32z^3n^3$
22. $5r^3s^5 + 10r^2s^2 - 15r^4s^2$
23. $15a^3b + 12a^2c - 3ad^4$
24. $20m^4y + 30m^2y^2 + 50m^3z^2$
25. $9x^2y^2z^4 - 18x^3y^2z$
26. $30m^5p^5q^3 + 20m^6p^4q^2$
27. $12p^5q^6 + 5r^2s^2 + 24p^3r^2$
28. $2m^8k^8 + 7q^4p^5 + 14m^6p^3$
29. $14a^3b^2 + 7a^2b - 21a^5b^3 + 42ab^4$
30. $12km^3 - 24k^3m^2 + 36k^2m^4 - 60k^4m^3$
31. $-15m^3p^3 - 6m^3p^4 - 9mp^3 + 30m^2p^3$
32. $-25x^3y^2 - 20x^4y^3 + 15x^5y^4 - 50x^6y^2$
33. $(m - 9)(m + 1) + (m - 9)(m + 2)$
34. $(a + 5)(a - 6) + (a + 5)(a - 1)$
35. $(3k - 7)(k + 2) + (3k - 7)(k + 5)$
36. $(5m - 11)(2m + 5) + (5m - 11)(m + 5)$
37. $(r - 6)(2r + 1) - (r - 6)(r + 3)$
38. $(y + 2)(2y + 3) - (y + 2)(y + 1)$

39. $m^5(r + s) + m^5(t + u)$
40. $z^3(k + m) + z^3(p + q)$
41. $4(3 - x)^2 - (3 - x)^3 + 3(3 - x)$
42. $2(t - s) + 4(t - s)^2 - (t - s)^3$
43. $15(2z + 1)^3 + 10(2z + 1)^2 - 25(2z + 1)$
44. $6(a + 2b)^2 - 4(a + 2b)^3 + 12(a + 2b)^4$
45. $5(m + p)^3 - 10(m + p)^2 - 15(m + p)^4$
46. $-9a^2(p + q) - 3a^3(p + q)^2 + 6a(p + q)^3$

Factor each of the following polynomials twice. First, use a common factor with a positive coefficient, and then use a common factor with a negative coefficient. See Example 6.

47. $24z^2 - 48z$
48. $39p^3 - 65p^4$
49. $-2x^5 + 6x^3 + 4x^2$
50. $-5a^3 + 10a^4 - 15a^5$
51. $-32a^4m^5 - 16a^2m^3 - 64a^5m^6$
52. $-144z^{11}n^5 + 16z^3n^{11} - 32z^4n^7$

Factor by grouping. See Examples 7–9.

53. $pq + 3rq + pm + 3rm$
54. $5x + 5a + 9bx + 9ab$
55. $2b + 2c + ab + ac$
56. $3am + 3ap + 2bm + 2bp$
57. $p^2 + pq - 3py - 3yq$
58. $r^2 + 6rs - 3rt - 18st$
59. $a^2b^2 + 2b^2 - 5a^2 - 10$
60. $m^2r^2 + 8r^2 - 3m^2 - 24$
61. $x^2 - 3x + 2x - 6$
62. $y^2 - 8y + 4y - 32$
63. $3r^2 - 2r + 15r - 10$
64. $2a^2 - 6a + 7a - 21$
65. $21y^2 + 14y - 15y - 10$
66. $18q^2 + 9q - 4q - 2$
67. $16p^2 + 6pq - 8pq - 3q^2$
68. $8r^2 + 6rs - 12rs - 9s^2$
69. $14m^2 + 21mq - 2mq - 3q^2$
70. $10y^2 + 4yz - 5y - 2z$
71. $3a^3 + 3ab^2 + 2a^2b + 2b^3$
72. $16m^3 - 4m^2p^2 - 4mp + p^3$
73. $1 - a + ab - b$
74. $2ab^2 - 8b^2 + a - 4$
75. $8 - 6y^3 - 12y + 9y^4$
76. $x^3y^2 + x^3 - 3y^2 - 3$

Factor each of the following polynomials. Assume that all variables used as exponents represent positive integers.

77. $p^{6m} - 2p^{4m}$

78. $4r^{3z} + 8r^{5z}$

79. $q^{3k} + 2q^{2k} + 3q^{k}$

80. $z^{2x} - z^{x} + z^{3x}$

81. $y^{r+5} + y^{r+4} + y^{r+2}$

82. $8k^{2z+3} + 2k^{2z+1} + 12k^{2z}$

83. $(3k - 7)(k + 2) - (7 - 3k)(2k + 1)$

84. $(5z + 1)(3z - 5) + (2z - 7)(5 - 3z)$

85. $r^{p}m^{p} + q^{p}m^{p} - r^{p}z^{p} - q^{p}z^{p}$

86. $6a^{z}b^{z} - 10b^{z} - 3a^{z}c^{z} + 5c^{z}$

Factor out the greatest common factor.

87. $3m^{-5} + m^{-3}$

88. $k^{-2} + 2k^{-4}$

89. $3p^{-3} + 2p^{-2} - 4p^{-1}$

90. $-5y^{-3} + 8y^{-2} + y^{-1}$

Review Exercises *Find each product by the FOIL method. See Section 3.4.*

91. $(2m - 1)(3m + 2)$

92. $(4p + 5)(3p - 7)$

93. $(8r + 5s)(2r - 3s)$

94. $(7y - 2x)(3y + 5x)$

95. $(9z - 7a)(2z + 5a)$

96. $(8p + 3q)(4p - q)$

97. $(2r - 5s)(7r + 3s)$

98. $(2a + 7b)(3a + 5b)$

3.6 Exercises

Factor each of the following trinomials. See Examples 1–9.

1. $c^2 + 4c - 5$ **2.** $d^2 + 9d + 8$ **3.** $p^2 + 6p + 8$ **4.** $m^2 + 15m + 56$

5. $a^2 - a - 12$ **6.** $z^2 + 2z - 35$ **7.** $r^2 - r - 20$ **8.** $y^2 - 2y - 35$

9. $x^2 - 3x - 40$ **10.** $a^2 - 6a - 16$ **11.** $k^2 - kn - 6n^2$ **12.** $a^2 + 3ab - 18b^2$

13. $y^2 - 3yx - 10x^2$ **14.** $p^2 - 2pq - 15q^2$ **15.** $a^2b^2 - 7ab + 12$ **16.** $y^2w^2 + 4yw - 21$

17. $5y^2 + y - 6$ **18.** $2r^2 - r - 3$ **19.** $3m^2 + 7m + 2$ **20.** $3y^2 + 14y + 8$

21. $8y^2 + 13y - 6$ **22.** $6x^2 + 13x + 6$ **23.** $18x^2 - 3x - 10$ **24.** $12m^2 - 8m - 15$

25. $35p^2 - 4p - 15$ **26.** $6m^2 - 17m - 14$ **27.** $12a^2 + 8ab - 15b^2$ **28.** $3m^2 + 7mk + 2k^2$

29. $4k^2 - 12ka + 9a^2$ **30.** $18a^2 - 3ab - 28b^2$ **31.** $35x^2 - 41xy - 24y^2$ **32.** $10a^2 + ab - 3b^2$

33. $8m^2 - 14mp - 39p^2$ **34.** $6x^2 - 5xy - 39y^2$ **35.** $6k^2p^2 + 13kp + 6$ **36.** $15z^2x^2 - 22zx - 5$

37. $12m^2 + 14m - 40$ **38.** $36t^2 + 30t - 50$ **39.** $18a^2 - 15a - 18$ **40.** $100r^2 - 90r + 20$

41. $6a^3 + 12a^2 - 90a$ **42.** $3m^4 + 6m^3 - 72m^2$ **43.** $13y^3 + 39y^2 - 52y$ **44.** $4p^3 + 24p^2 - 64p$

45. $2x^3y^3 - 48x^2y^4 + 288xy^5$ **46.** $6m^3n^2 - 24m^2n^3 - 30mn^4$

Factor each of the following. See Examples 10 and 11.

47. $3x^4 - 14x^2 - 5$ **48.** $3p^4 - 8p^2 - 3$ **49.** $z^4 - 7z^2 - 30$

50. $k^4 + k^2 - 12$ **51.** $6x^4 + 5x^2 - 25$ **52.** $6a^4 - 11a^2 - 10$

53. $12p^4 + 28p^2r - 5r^2$ **54.** $2y^4 + xy^2 - 6x^2$

55. $4x^4 + 33x^2a^2 - 27a^4$ **56.** $2p^4 + 31p^2q^2 - 16q^4$

Find a polynomial that can be factored as follows.

57. $(3q + 7h)(q - 2h)$ **58.** $(5p - 2q)(3p + 4q)$

59. $-9a(a - 5b)(2a + 7b)$ **60.** $12z^2(5z + x)(2z - x)$

Factor each of the following. Assume that all variables used as exponents represent positive integers. See Examples 10 and 11.

61. $6(p + 3)^2 + 13(p + 3) + 5$ **62.** $10(m - 5)^2 - 9(m - 5) - 9$

63. $6(z + k)^2 - 7(z + k) - 5$ **64.** $3(r + m)^2 - 10(r + m) - 25$

65. $a^2(a + b)^2 - ab(a + b)^2 - 6b^2(a + b)^2$ **66.** $m^2(m - p) + mp(m - p) - 2p^2(m - p)$

67. $p^2(p + q) + 4pq(p + q) + 3q^2(p + q)$ **68.** $2k^2(5 - y) - 7k(5 - y) + 5(5 - y)$

69. $z^2(z - x) - zx(x - z) - 2x^2(z - x)$ **70.** $r^2(r - s) - 5rs(s - r) - 6s^2(r - s)$

71. $p^{2n} - p^n - 6$ **72.** $k^{2y} + 4k^y - 5$

73. $6z^{4r} - 5z^{2r} - 4$ **74.** $12a^{4p} + 11a^{2p} + 2$

75. $36k^{3r} + 30k^{2r} + 4k^r$ **76.** $30y^{7a} - 26y^{6a} - 40y^{5a}$

Review Exercises *Simplify. See Section 3.2.*

77. -5^0 **78.** $\left(\frac{5}{4}\right)^{-2}$ **79.** $\frac{(m^2p)^{-1}}{mp^2}$ **80.** $\frac{(2rs)^3}{(r^{-1}s)^2}$

Find each product. See Section 3.4.

81. $(2m - 5)(2m + 5)$ **82.** $(3p + 2q)(3p - 2q)$ **83.** $(5a - 3b)^2$

84. $(2z + 5x)^2$ **85.** $(y - 2)(y^2 + 2y + 4)$ **86.** $(5a + 3)(25a^2 - 15a + 9)$

3.7 Exercises

Factor each of the following. See Examples 1–4.

1. $x^2 - 25$ **2.** $9 - p^2$ **3.** $36m^2 - 25$

4. $4x^2 - 49$ **5.** $16y^2 - 81q^2$ **6.** $9m^2 - 100r^2$

7. $16 - 25a^2b^2$ **8.** $49 - 64x^2z^2$ **9.** $a^4 - 4b^4$

10. $m^2p^2 - 49r^2s^2$ **11.** $x^2 + 4x + 4$ **12.** $y^2 + 6y + 9$

13. $a^2 - 10a + 25$ **14.** $b^2 - 8b + 16$ **15.** $9r^2 - 6rs + s^2$

16. $4a^2 - 20ab + 25b^2$ **17.** $25x^2y^2 - 20xy + 4$ **18.** $9k^2q^2 + 24kq + 16$

19. $72m^2 - 120mp + 50p^2$ **20.** $100y^2 - 100yz + 25z^2$ **21.** $8a^3 + 1$

22. $125a^3 - 1$ **23.** $27x^3 - 64y^3$ **24.** $8a^3 + 125m^3$

25. $64x^3 + 125y^3$ **26.** $216z^3 - x^3$ **27.** $125m^3 - 8p^3$

28. $64y^3 - 1331x^3$ **29.** $1000 + 27r^3s^3$ **30.** $343 + 1000a^3b^3$

31. $64v^6 + 1$ **32.** $m^6 - 8$

Factor each of the following.

33. $(x + y)^2 - 16$ **34.** $(a + b)^2 - 100$ **35.** $25 - (r + 3s)^2$

36. $81 - (2k + z)^2$ **37.** $m^2 - (3p - 5)^2$ **38.** $w^2 - (2z - 3)^2$

39. $(a + b)^2 - (a - b)^2$ **40.** $(c - d)^2 - (c + d)^2$ **41.** $(a + b)^2 + 2(a + b) + 1$

42. $(x + y)^2 + 6(x + y) + 9$ **43.** $(m - p)^2 + 4(m - p) + 4$ **44.** $(w - r)^2 + 8(w - r) + 16$

45. $p^2 - 6p + 9 - r^2$ **46.** $k^2 - 10k + 25 - z^2$ **47.** $9y^2 - 30y + 25 - 16x^2$

48. $25a^2 - 20a + 4 - 9b^2$ **49.** $r^2 - 16s^2 + 24s - 9$ **50.** $t^2 - 16u^2 + 8u - 1$

51. $64 - (a - b)^3$ **52.** $(r + 1)^3 - 1$ **53.** $(p - 5)^3 + 125$

54. $m^3 + (m + 3)^3$ **55.** $a^3 - (a - 4)^3$ **56.** $(p + q)^3 - (p - q)^3$

Find a value of b or c so that the following will be perfect squares.

57. $p^2 + 6p + c$ **58.** $y^2 - 14y + c$ **59.** $9z^2 - 30z + c$

60. $16r^2 + 24r + c$ **61.** $16q^2 + bq + 25$ **62.** $36x^2 + bx + 25$

Factor each of the following. Assume that all variables used as exponents represent positive integers.

63. $16m^{4x} - 9$ **64.** $100m^{2q} - 81$ **65.** $64r^{8z} - 1$

66. $4 - 49x^{4y}$ **67.** $100m^{2z} - 9p^{8z}$ **68.** $16k^{8b} - 25m^{4b}$

69. $9a^{4z} - 30a^{2z} + 25$ **70.** $121p^{8k} + 44p^{4k} + 4$ **71.** $x^{3n} - 8$

72. $216 + b^{3k}$ **73.** $27z^{12y} + 125x^{6y}$ **74.** $1000k^{15r} - m^{21r}$

Review Exercises

Factor completely. See Sections 3.5 and 3.6.

75. $16y^2 - 24y + 32y^3$ **76.** $9z^2 - 10z^5 + z^7$ **77.** $xy + 2y + 4x + 8$

78. $a^2b^2 + 3b^2 + 2a^2 + 6$ **79.** $y^2 + y - 2$ **80.** $m^2 - 4m - 21$

81. $6r^2 + 19rz - 7z^2$ **82.** $10w^2 + 19wx + 6x^2$

3.8 Exercises

Factor each of the following polynomials. Assume all variables used as exponents are positive integers.

1. $100a^2 - 9b^2$
2. $10r^2 + 13r - 3$
3. $3p^4 - 3p^3 - 90p^2$
4. $k^4 - 16$
5. $3a^2pq + 3abpq - 90b^2pq$
6. $49z^2 - 16$
7. $225p^2 + 256$
8. $x^3 - 1000$
9. $6b^2 - 17b - 3$
10. $k^2 - 6k - 16$
11. $18m^3n + 3m^2n^2 - 6mn^3$
12. $6t^2 + 19tu - 77u^2$
13. $2p^2 + 11pq + 15q^2$
14. $40p - 32r$
15. $9m^2 - 45m + 18m^3$
16. $4k^2 + 28kr + 49r^2$
17. $54m^3 - 2000$
18. $mn - 2n - 5m - 10$
19. $2a^2 - 7a - 4$
20. $9m^2 - 30mn + 25n^2$
21. $kq - 9q + kr - 9r$
22. $56k^3 - 875$
23. $9r^2 + 100$
24. $16z^3x^2 - 32z^2x$
25. $8p^3 - 125$
26. $yx + yw + zx + zw$
27. $x^4 - 625$
28. $2m^2 - mn - 15n^2$
29. $p^3 + 64$
30. $48y^2z^3 - 28y^3z^4$
31. $64m^2 - 625$
32. $14z^2 - 3zk - 2k^2$
33. $12z^3 - 6z^2 + 18z$
34. $225k^2 - 36r^2$
35. $256b^2 - 400c^2$
36. $z^2 - zp - 20p^2$
37. $1000z^3 + 512$
38. $64m^2 - 25n^2$
39. $10r^2 + 23rs - 5s^2$
40. $12k^2 - 17kq - 5q^2$
41. $24p^3q + 52p^2q^2 + 20pq^3$
42. $32x^2 + 16x^3 - 24x^5$
43. $48k^4 - 243$
44. $14x^2 - 25xq - 25q^2$
45. $50p^2 - 162$
46. $y^2 + 3y - 10$
47. $12m^2rx + 4mnrx + 40n^2rx$
48. $18p^2 + 53pr - 35r^2$
49. $21a^2 - 5ab - 4b^2$
50. $(x - 2y)^2 - 4$
51. $(3m - n)^2 - 25$
52. $(5r + 2s)^2 - 6(5r + 2s) + 9$
53. $(p + 8q)^2 - 10(p + 8q) + 25$
54. $z^4 - 9z^2 + 20$
55. $21m^4 - 32m^2 - 5$
56. $(x - y)^3 - (27 - y)^3$
57. $z^{4x} - w^{2x}$
58. $xy^2z^{-1} + x^2yz^{-2}$ $(z \neq 0)$
59. $gh^3k^{-2} - g^2h^2k^{-3}$ $(k \neq 0)$
60. $2a^x + 4a^{2x} + 8a^{3x}$
61. $3m^{2k} - 7m^k - 6$
62. $2p^{2a} + 10p^a - 28$
63. $m^2 - 4m + 4 - n^2 + 6n - 9$
64. $x^{2p} - y^{2p}$
65. $15c^{4y} + 3c^{2y} - 6c^y$
66. $k^2 + 2kp + p^2 - a^2 - 2ab - b^2$
67. $8 + (z + w)^3$

Review Exercises

Simplify. See Section 3.1.

68. $\dfrac{2^4 \cdot 2^{-3}}{2^{-2}}$
69. $\dfrac{3^6 \cdot 3^{-1}}{3^3}$
70. $\dfrac{p^5p^{-2}}{p^{-1}p^4}$ $(p \neq 0)$
71. $\dfrac{2k^{-1}k}{k^2k^{-2}}$ $(k \neq 0)$

Solve each equation. See Section 2.1.

72. $3x + 1 = 13$
73. $5r - 2 = 8$
74. $-2q + 3 = 7$
75. $-a + 4 = 5$
76. $4p = 0$
77. $-9r = 0$
78. $-2z + 8 = 9$
79. $1 - 3y = 5$

Section 3.5 (page 126)

1. $15(k + 2)$ **3.** $2p(3p + 2)$ **5.** $4mp(2m - p)$ **7.** $xy(5 - 8y)$ **9.** $2m^2(4m^2 + 3m - 2)$
11. $2t^3(5t^2 - 4t - 8)$ **13.** $3rs(2r - s - 3r^2)$ **15.** $xy(2x - 3y + 4xy)$
17. $12km^2(m - 2k^2 + 3km^2)$ **19.** $16z^3m^4(9z^8 + m - 2zm)$ **21.** $16zn^3(zn^3 + 4n^4 - 2z^2)$
23. $3a(5a^2b + 4ac - d^4)$ **25.** $9x^2y^2z(z^3 - 2x)$ **27.** No common factor other than 1
29. $7ab(2a^2b + a - 3a^4b^2 + 6b^3)$ **31.** $3mp^3(-5m^2 - 2m^2p - 3 + 10m)$ or $-3mp^3(5m^2 + 2m^2p + 3 - 10m)$ **33.** $(m - 9)(2m + 3)$ **35.** $(3k - 7)(2k + 7)$
37. $(r - 6)(r - 2)$ **39.** $m^5(r + s + t + u)$ **41.** $(3 - x)(6 + 2x - x^2)$
43. $20z(2z + 1)(3z + 4)$ **45.** $5(m + p)^2(m + p - 2 - 3m^2 - 6mp - 3p^2)$
47. $24z(z - 2)$ or $-24z(-z + 2)$ **49.** $2x^2(-x^3 + 3x + 2)$ or $-2x^2(x^3 - 3x - 2)$
51. $16a^2m^3(-2a^2m^2 - 1 - 4a^3m^3)$ or $-16a^2m^3(2a^2m^2 + 1 + 4a^3m^3)$ **53.** $(p + 3r)(q + m)$
55. $(b + c)(2 + a)$ **57.** $(p + q)(p - 3y)$ **59.** $(a^2 + 2)(b^2 - 5)$ **61.** $(x - 3)(x + 2)$
63. $(3r - 2)(r + 5)$ **65.** $(3y + 2)(7y - 5)$ **67.** $(8p + 3q)(2p - q)$ **69.** $(2m + 3q)(7m - q)$
71. $(a^2 + b^2)(3a + 2b)$ **73.** $(1 - a)(1 - b)$ **75.** $(4 - 3y^3)(2 - 3y)$ **77.** $p^{4m}(p^{2m} - 2)$
79. $q^k(q^{2k} + 2q^k + 3)$ **81.** $y^{r+2}(y^3 + y^2 + 1)$ **83.** $3(3k - 7)(k + 1)$ **85.** $(r^p + q^p)(m^p - z^p)$
87. $m^{-5}(3 + m^2)$ or $(m^2 + 3)/m^5$ **89.** $p^{-3}(3 + 2p - 4p^2)$ or $(-4p^2 + 2p + 3)/p^3$ **91.** $6m^2 + m - 2$
93. $16r^2 - 14rs - 15s^2$ **95.** $18z^2 + 31za - 35a^2$ **97.** $14r^2 - 29rs - 15s^2$

Section 3.6 (page 133)

1. $(c + 5)(c - 1)$ **3.** $(p + 2)(p + 4)$ **5.** $(a - 4)(a + 3)$ **7.** $(r + 4)(r - 5)$
9. $(x - 8)(x + 5)$ **11.** $(k - 3n)(k + 2n)$ **13.** $(y - 5x)(y + 2x)$ **15.** $(ab - 3)(ab - 4)$
17. $(5y + 6)(y - 1)$ **19.** $(3m + 1)(m + 2)$ **21.** $(8y - 3)(y + 2)$ **23.** $(3x + 2)(6x - 5)$
25. $(7p - 5)(5p + 3)$ **27.** $(6a - 5b)(2a + 3b)$ **29.** $(2k - 3a)(2k - 3a)$ or $(2k - 3a)^2$
31. $(7x + 3y)(5x - 8y)$ **33.** $(2m + 3p)(4m - 13p)$ **35.** $(3kp + 2)(2kp + 3)$
37. $2(3m - 4)(2m + 5)$ **39.** $3(2a - 3)(3a + 2)$ **41.** $6a(a - 3)(a + 5)$
43. $13y(y + 4)(y - 1)$ **45.** $2xy^3(x - 12y)(x - 12y)$ or $2xy^3(x - 12y)^2$ **47.** $(3x^2 + 1)(x^2 - 5)$
49. $(z^2 + 3)(z^2 - 10)$ **51.** $(3x^2 - 5)(2x^2 + 5)$ **53.** $(6p^2 - r)(2p^2 + 5r)$
55. $(4x^2 - 3a^2)(x^2 + 9a^2)$ **57.** $3q^2 + qh - 14h^2$ **59.** $-18a^3 + 27a^2b + 315ab^2$
61. $(3p + 14)(2p + 7)$ **63.** $(3z + 3k - 5)(2z + 2k + 1)$ **65.** $(a + b)^2(a - 3b)(a + 2b)$
67. $(p + q)(p + 3q)(p + q)$ or $(p + q)^2(p + 3q)$ **69.** $(z - x)(z - x)(z + 2x)$ or $(z - x)^2(z + 2x)$
71. $(p^n - 3)(p^n + 2)$ **73.** $(2z^{2r} + 1)(3z^{2r} - 4)$ **75.** $2k^r(6k^r + 1)(3k^r + 2)$ **77.** -1
79. $1/(m^3p^3)$ **81.** $4m^2 - 25$ **83.** $25a^2 - 30ab + 9b^2$ **85.** $y^3 - 8$

Section 3.7 (page 137)

1. $(x + 5)(x - 5)$ **3.** $(6m + 5)(6m - 5)$ **5.** $(4y + 9q)(4y - 9q)$ **7.** $(4 + 5ab)(4 - 5ab)$
9. $(a^2 + 2b^2)(a^2 - 2b^2)$ **11.** $(x + 2)^2$ **13.** $(a - 5)^2$ **15.** $(3r - s)^2$ **17.** $(5xy - 2)^2$
19. $2(6m - 5p)^2$ **21.** $(2a + 1)(4a^2 - 2a + 1)$ **23.** $(3x - 4y)(9x^2 + 12xy + 16y^2)$
25. $(4x + 5y)(16x^2 - 20xy + 25y^2)$ **27.** $(5m - 2p)(25m^2 + 10mp + 4p^2)$
29. $(10 + 3rs)(100 - 30rs + 9r^2s^2)$ **31.** $(4y^2 + 1)(16y^4 - 4y^2 + 1)$ **33.** $(x + y + 4)(x + y - 4)$
35. $(5 + r + 3s)(5 - r - 3s)$ **37.** $(m + 3p - 5)(m - 3p + 5)$ **39.** $4ab$ **41.** $(a + b + 1)^2$
43. $(m - p + 2)^2$ **45.** $(p - 3 + r)(p - 3 - r)$ **47.** $(3y - 5 + 4x)(3y - 5 - 4x)$
49. $(r + 4s - 3)(r - 4s + 3)$ **51.** $(4 - a + b)(16 + 4a - 4b + a^2 - 2ab + b^2)$
53. $p(p^2 - 15p + 75)$ **55.** $4(3a^2 - 12a + 16)$ **57.** 9 **59.** 25 **61.** 40 or -40
63. $(4m^{2x} + 3)(4m^{2x} - 3)$ **65.** $(8r^{4z} + 1)(8r^{4z} - 1)$ **67.** $(10m^z + 3p^{4z})(10m^z - 3p^{4z})$

69. $(3a^{2z} - 5)^2$ **71.** $(x^n - 2)(x^{2n} + 2x^n + 4)$ **73.** $(3z^{4y} + 5x^{2y})(9z^{8y} - 15z^{4y}x^{2y} + 25x^{4y})$
75. $8y(2y - 3 + 4y^2)$ **77.** $(x + 2)(y + 4)$ **79.** $(y + 2)(y - 1)$ **81.** $(3r - z)(2r + 7z)$

Section 3.8 (page 141)

1. $(10a + 3b)(10a - 3b)$ **3.** $3p^2(p - 6)(p + 5)$ **5.** $3pq(a + 6b)(a - 5b)$ **7.** Cannot be factored further **9.** $(6b + 1)(b - 3)$ **11.** $3mn(3m + 2n)(2m - n)$ **13.** $(2p + 5q)(p + 3q)$
15. $9m(m - 5 + 2m^2)$ **17.** $2(3m - 10)(9m^2 + 30m + 100)$ **19.** $(2a + 1)(a - 4)$
21. $(k - 9)(q + r)$ **23.** Cannot be factored further **25.** $(2p - 5)(4p^2 + 10p + 25)$
27. $(x - 5)(x + 5)(x^2 + 25)$ **29.** $(p + 4)(p^2 - 4p + 16)$ **31.** $(8m + 25)(8m - 25)$
33. $6z(2z^2 - z + 3)$ **35.** $16(4b + 5c)(4b - 5c)$ **37.** $8(5z + 4)(25z^2 - 20z + 16)$
39. $(5r - s)(2r + 5s)$ **41.** $4pq(2p + q)(3p + 5q)$ **43.** $3(4k^2 + 9)(2k + 3)(2k - 3)$
45. $2(5p + 9)(5p - 9)$ **47.** $4rx(3m^2 + mn + 10n^2)$ **49.** $(7a - 4b)(3a + b)$
51. $(3m - n + 5)(3m - n - 5)$ **53.** $(p + 8q - 5)^2$ **55.** $(7m^2 + 1)(3m^2 - 5)$
57. $(z^{2x} + w^x)(z^{2x} - w^x)$ **59.** $gh^2k^{-3}(hk - g)$ **61.** $(3m^k + 2)(m^k - 3)$
63. $(m + n - 5)(m - n + 1)$ **65.** $3c^y(5c^{3y} + c^y - 2)$
67. $(2 + z + w)(4 - 2z - 2w + z^2 + 2zw + w^2)$ **69.** 9 **71.** 2 **73.** $\{2\}$ **75.** $\{-1\}$
77. $\{0\}$ **79.** $\{-4/3\}$