DIAGNOSING READINESS *page 454*

1. 1, 2, 3, 4, 6, 12 **2.** 1, 2, 4, 7, 8, 14, 28, 56 **3.** 1, 31 **4.** 1, 3, 9, 27 **5.** 1, 2, 5, 10, 11, 22, 55, 110 **6.** 1, 5, 13, 65 **7.** 1, 2, 5, 10, 25, 50 **8.** 1, 2, 4, 5, 8, 10, 20, 25, 40, 50, 100, 200 **9.** 1, 11 **10.** 1, 2, 3, 6, 7, 14, 21, 42 **11.** 1, 2, 3, 6, 11, 22, 33, 66 **12.** 1, 73 **13.** $2x^2 - x + x^2 - 3x = 3x^2 - 4x$ **14.** $-b + 2 + 3b + 4 = (-1 + 3)b + 2 + 4 = 2b + 6$ **15.** $-5y - y^2 + 4y^2 - 6y = (4 - 1)y^2 - (5 + 6)y = 3y^2 - 11y$ **16.** $(3w - 2w^2 + 4w - 2w^2)\frac{1}{6} = [(-2 - 2)w^2 + (3 + 4)w]\frac{1}{6} = (-4w^2 + 7w)\frac{1}{6} = -\frac{4}{6}w^2 + \frac{7}{6}w = -\frac{2}{3}w^2 + \frac{7}{6}w$ **17.** $-8(z + 2) + 5(3z - 10) = -8z - 16 + 15z - 50 = 7z - 66$ **18.** $2(x + 4x^2 - 2x - 2x^2) = 2(2x^2 - x) = 2(2x^2) - 2(x) = 4x^2 - 2x$ **19.** $12t - 5t^2 - 2t - t^2 = -6t^2 + 10t$ **20.** $p - 3 - (p^2 - 3) = -p^2 + p$ **21.** $(7w)^2 = 7^2w^2 = 49w^2$ **22.** $(-5n^2)(-5n) = 25n^{2+1} = 25n^3$ **23.** $(3z^2)^2 = 3^2(z^2)^2 = 9z^{2\cdot 2} = 9z^4$ **24.** $(2t^3)(5t^4) = 10t^{3+4} = 10t^7$ **25.** $(4y^3)^2 = 4^2y^{3\cdot 2} = 16y^6$ **26.** $(-9ab)^2 = (-9)^2a^2b^2 = 81a^2b^2$ **27.** $4(x^2)^2 = 4x^{2\cdot 2} = 4x^4$ **28.** $(-6p^4)^2 = (-6)^2p^{4\cdot 2} = 36p^8$ **29.** $\frac{x^5y^8}{x^3y^4} = x^{5-3}y^{8-4} = x^2y^4$ **30.** $\frac{(3c)^2}{(3c)} = \frac{9c^2}{3c} = 3c$ **31.** $\frac{-5t}{(10t^3)(2t)} = \frac{-5t}{20t^4} = -\frac{1}{4t^{4-1}} = -\frac{1}{4t^3}$ **32.** $\frac{(3a)(4a^3)}{6a^2} = 2a^{1+3-2} = 2a^2$

9-1 Adding and Subtracting Polynomials *pages 456–461*

Check Skills You'll Need p. 456 For complete solutions see *Daily Skills Check and Lesson Quiz Transparencies* or *Presentation Pro CD-ROM.*

1. $19t$ **2.** $39g$ **3.** $-8k$ **4.** $11b - 6$ **5.** $-3n^2$ **6.** $7x^2$

Investigation 1. B; Casic bought s bags of birdseed and m bags of millet. **2.** Davis: $24m$; Brooks: $3.99s + 2c$; Martino: $3.99s + 2.29g + 1.89p$ **3.** $3.99 \cdot 10 + 2.29 \cdot 4 + 1.89 \cdot 2 = 39.90 + 9.16 + 3.78 = 52.84$; \$52.84

Check Understanding 1. $9x^0 = 9$; degree is 0 (the power of x); the degree of a nonzero constant is zero. **2a.** $-9x^4 + 6x^2 + 7$; fourth-degree trinomial **2b.** $-y^3 + 3y - 4$; cubic trinomial **2c.** $-4v + 8$; linear binomial

3a.
$$\begin{array}{r} 12m^2 + 4 \\ +\quad 8m^2 + 5 \\ \hline 20m^2 + 9 \end{array}$$

3b. $(t^2 - 6) + (3t^2 + 11) = (t^2 + 3t^2) + (-6 + 11) = 4t^2 + 5$ **3c.** $(9w^3 + 8w^2) + (7w^3 + 4) = (9 + 7)w^3 + 8w^2 + 4 = 16w^3 + 8w^2 + 4$

4a.
$$\begin{array}{rrrr} & v^3 + & 6v^2 - & v \\ - & & 9v^3 - 7v^2 + & 3v \\ \hline & -8v^3 + & 13v^2 - & 4v \end{array}$$

4b. $(30d^3 - 29d^2 - 3d) - (2d^3 + d^2) = (30 - 2)d^3 + (-29 - 1)d^2 - 3d = 28d^3 - 30d^2 - 3d$ **4c.** $(4x^2 + 5x + 1) - (6x^2 + x + 8) = (4 - 6)x^2 + (5 - 1)x + (1 - 8) = -2x^2 + 4x - 7$

Exercises 1. 1 **2.** 3 **3.** 0 **4.** $2 + 8 = 10$ **5.** $1 + 3 = 4$ **6.** 0 **7.** 4 **8.** 0 **9.** quadratic trinomial **10.** linear binomial **11.** cubic trinomial **12.** not a polynomial **13.** constant monomial **14.** quadratic binomial **15.** $4x - 3x^2 = -3x^2 + 4x$; quadratic binomial **16.** $4x + 9$; linear binomial **17.** $c^2 - 2 + 4c = c^2 + 4c - 2$; quadratic trinomial **18.** $9z^2 - 11z^2 + 5z - 5 = -2z^2 + 5z - 5$; quadratic trinomial **19.** $y - 7y^3 + 15y^8 = 15y^8 - 7y^3 + y$; eighth-degree trinomial **20.** $-10 + 4q^4 - 8q + 3q^2 = 4q^4 + 3q^2 - 8q - 10$; fourth-degree polynomial with 4 terms

21.
$$\begin{array}{r} 5m^2 + 9 \\ +\quad 3m^2 + 6 \\ \hline 8m^2 + 15 \end{array}$$

22.
$$\begin{array}{r} 3k - 8 \\ +\quad 7k + 12 \\ \hline 10k + 4 \end{array}$$

23.
$$\begin{array}{r} w^2 + w - 4 \\ +\quad 7w^2 - 4w + 8 \\ \hline 8w^2 - 3w + 4 \end{array}$$

24.
$$\begin{array}{r} 8x^2 + 1 \\ +\quad 12x^2 + 6 \\ \hline 20x^2 + 7 \end{array}$$

25. $(g^4 + 4g) + (9g^4 + 7g) = (1 + 9)g^4 + (4 + 7)g = 10g^4 + 11g$ **26.** $(a^2 + a + 1) + (5a^2 - 8a + 20) = (1 + 5)a^2 + (1 - 8)a + (1 + 20) = 6a^2 - 7a + 21$

27.
$$\begin{array}{rrrr} & & 7y^3 - 3y^2 + & 4y \\ + & 8y^4 & & + 3y^2 \\ \hline & 8y^4 + 7y^3 & & + 4y \end{array}$$

28. $6c - 5 - (4c + 9) = 6c - 5 - 4c - 9 = (6c - 4c) + (-5 - 9) = 2c - 14$

29. $2b + 6 - (b + 5) = 2b + 6 - b - 5 = (2b - b) + (6 - 5) = b + 1$

30. $7h^2 + 4h - 8 - 3h^2 + 2h - 10 = (7h^2 - 3h^2) + (4h + 2h) + (-8 - 10) = 4h^2 + 6h - 18$

31. $(17n^4 + 2n^3) - (10n^4 + n^3) = (17 - 10)n^4 + (2 - 1)n^3 = 7n^4 + n^3$

32. $(24x^5 + 12x) - (9x^5 + 11x) = (24 - 9)x^5 + (12 - 11)x = 15x^5 + x$

33. $(6w^2 - 3w + 1) - (w^2 + w - 9) = (6 - 1)w^2 - (3 + 1)w + (1 + 9) = 5w^2 - 4w + 10$

34. $(-5x^4 + x^2) - (x^3 + 8x^2 - x) = -5x^4 - x^3 - 7x^2 + x$

35. $(7y^2 - 3y + 4y) + (8y^2 + 3y^2 + 4y) = (7 + 8 + 3)y^2 + (-3 + 4 + 4)y = 18y^2 + 5y$

36. $(2x^3 - 5x^2 - 1) - (8x^3 + 3 - 8x^2) = -6x^3 + 3x^2 - 4$ **37.** $(-7z^3 + 3z - 1) - (-6z^2 + z + 4) = -7z^3 + 6z^2 + 2z - 5$

38. $(7a^3 - a + 3a^2) + (8a^2 - 3a - 4) = 7a^3 + 11a^2 - 4a - 4$ **39.** $2(9c - 10) + 2(5c + 2) = (18 + 10)c + (-20 + 4) = 28c - 16$
40. $9x + (8x - 2) + (17x - 6) + (5x + 1) = (9 + 8 + 17 + 5)x + (-2 - 6 + 1) = 39x - 7$
41. Kwan wrote $-(-4x - 2) = -4x - 2$; correct result is $-(-4x - 2) = 4x + 2$. **42a.** *monogram*: several letters combined to form a single (*mono-*) design (*gram*); *binocular:* relating to the use of both (two, *bi-*) eyes (*oculus*); *tricuspid*: having three cusps (high points), as of a molar tooth; *polyglot*: a person with knowledge of several (*poly-*) languages **42b.** Answers may vary. Samples: monopoly, biathlon, tripod, polychrome **42c.** Yes; the prefixes are used to identify the number of terms in a polynomial.
43. $(x^3 + 3x) + (12x - x^4) = -x^4 + x^3 + 15x$
44. $(6g - 7g^8) - (4g + 2g^3 + 11g^2) = -7g^8 - 2g^3 - 11g^2 + 2g$
45. $(2h^4 - 5h^9) - (-8h^5 + h^{10}) = -h^{10} - 5h^9 + 8h^5 + 2h^4$
46. $(-4t^4 - 9t + 6) + (13t + 5t^4) = t^4 + 4t + 6$
47. $(8b - 6b^7 + 3b^8) + (2b^7 - 5b^9) = -5b^9 + 3b^8 - 4b^7 + 8b$
48. $(11 + k^3 - 6k^4) - (k^2 - k^4) = -5k^4 + k^3 - k^2 + 11$ **49.** Perimeter $= 5x + 2 + 5x - 4 + 6x - 8 + ax + b + 4x = (20 + a)x - 10 + b = 25x + 8$;

$$20 + a = 25$$
$$a = 5$$
$$-10 + b = 8$$
$$b = 18$$

Missing length is $ax + b = 5x + 18$.
50. Perimeter $= xa + y + 8a - 9 + 6a + 8 = (14 + x)a - 1 + y = 23a - 7$;

$$14 + x = 23$$
$$x = 9$$
$$-1 + y = -7$$
$$y = -6$$

Missing length is $xa + y = 9a - 6$.
51. No; both terms of a binomial cannot be constants.
52a. P: $y = 2x - 1$; Q: $y = 0.5x + 3$
52b. $D(x) = y_P - y_Q = 2x - 1 - (0.5x + 3) = 1.5x - 4$
52c. $D = 0$ for $1.5x - 4 = 0$; $1.5x = 4$; $x = \frac{4}{1.5} = \frac{8}{3} = 2\frac{2}{3}$
52d. The lines intersect at $x = 2\frac{2}{3}$.
53. $(ab^2 + ba^3) + (4a^3b - ab^2 - 5ab) = (1 + 4)a^3b - 5ab = 5a^3b - 5ab$
54. $(9pq^6 - 11p^4q) - (-5pq^6 + p^4q^4) = -p^4q^4 + 14pq^6 - 11p^4q$ **55a.** $p(t) = m(t) + w(t) = 57t + 2332.3$ **55b.** $p(5) = 57 \cdot 5 + 2332.3 = 2617.3$; about 2,617,300 men and women enrolled. **55c.** the difference between the number of men and women enrolled in a college **56.** $n + n + 2 + n + 4 + n + 6 = 4n + 12$; the answer is D. **57.** $(8x^2 + 3) + (7x^2 + 10) = 15x^2 + 13$; the answer is G. **58. A.** sum $= 3 - 2 + 1 + 8 = 10$; **B,** sum $= 3 - 6 + 9 = 6$; the answer is A.
59. A. $5 + 3 + 0 = 8$. **B.** $4 + 3 + 1 + 0 = 8$; the answer is C. **60. A.** $4 \cdot 2^2 - 9 \cdot 2 + 7 = 16 - 18 + 7 = 5$; **B.** $-2^2 + 12 \cdot 2 + 8 = -4 + 24 + 8 = 28$; the answer is B. **61. A.** $(2k - 6) + (3k + 1) = 5k - 5$; **B.** $(k^2 + 4k) - (k^2 - k + 5) = 5k - 5$; the answer is C.
62. [2] $(9x^3 - 4x^2 + 1) - (x^2 + 2) = 9x^3 - (4 + 1)x^2 + (1 - 2) = 9x^3 - 5x^2 - 1$
[1] one incorrect term OR no work shown
63. 2 **64.** 1.4 **65.** 5 **66.** 5 **67.** exponential growth; $3 > 1$ **68.** exponential decay; $0.4 < 1$ **69.** exponential growth; $7 > 1$ **70.** exponential decay; $0.5 < 1$ **71.** $7^8 \cdot 7^{10} = 7^{8+10} = 7^{18}$ **72.** $2^6 \cdot 2^{-7} = 2^{6+(-7)} = 2^{-1} = \frac{1}{2}$
73. $(4x^2)(9x^3) = (4 \cdot 9)(x^{2+3}) = 36x^5$ **74.** $(3ab)(a^2b) = 3a^{1+2}b^{1+1} = 3a^3b^2$ **75.** $(-5t^2)(6t^{-9}) = (-5 \cdot 6)t^{2-9} = -30t^{-7} = -\frac{30}{t^7}$ **76.** $(-3)^6 \cdot (-3)^{-4} = (-3)^{6-4} = (-3)^2 = 9$ **77.** $(6h^2)(-2h^8) = 6(-2)h^{2+8} = -12h^{10}$
78. $(2q^5)(5q^2) = 10q^7$ **79.** $y = |x| + 5$ **80.** $y = |x - 6|$ **81.** $y = |x| - 12$ **82.** $y = |x| + 7$ **83.** $y = |x + 10|$ **84.** $y = |x + 0.4|$ **85.** $y = |x| + 5.2$ **86.** $y = |x| - 2.3$

9-2 Multiplying and Factoring *pages 462–465*

Check Skills You'll Need p. 462 For complete solutions see *Daily Skills Check and Lesson Quiz Transparencies* or *Presentation Pro CD-ROM.*

1. 906 **2.** 287 **3.** 4536 **4.** $24 + 20x$ **5.** $-16y - 8$ **6.** $25v - 5$ **7.** $7p - 14$ **8.** $54 - 9x$ **9.** $-8q + 2$

Check Understanding 1a. $4b(5b^2 + b + 6) = (4b)(5b^2) + (4b)b + (4b)6 = 20b^{1+2} + 4b^{1+1} + 24b = 20b^3 + 4b^2 + 24b$ **1b.** $-7h(3h^2 - 8h - 1) = -(7 \cdot 3)(hh^2) + (7 \cdot 8)hh + 7h = -21h^3 + 56h^2 + 7h$
1c. $2x(x^2 - 6x + 5) = 2x^3 - 12x^2 + 10x$
2a.

$$5v^5 = 5 \cdot v \cdot v \cdot v \cdot v \cdot v$$
$$10v^3 = 2 \cdot 5 \cdot v \cdot v \cdot v$$

GCF $= 5 \cdot v \cdot v \cdot v = 5v^3$
2b. $3t^2 - 18 = (3)t^2 - (3)6$; GCF $= 3$
2c. $4b^3 - 2b^2 - 6b = (2b)2b^2 - (2b)b - (2b)3$; GCF $= 2b$ **3a.** $8x^2 - 12x = (4x)2x - (4x)3 = 4x(2x - 3)$
3b. $5d^3 + 10d = (5d)d^2 + (5d)2 = 5d(d^2 + 2)$
3c. $6m^3 - 12m^2 - 24m = (6m)m^2 - (6m)2m - (6m)4 = 6m(m^2 - 2m - 4)$

Exercises 1. $8m(m + 6) = 8m^2 + 48m$ **2.** $(x + 10)3x = x \cdot 3x + 10 \cdot 3x = 3x^2 + 30x$ **3.** $9k(7k + 4) = (9 \cdot 7)k^{1+1} + 9k \cdot 4 = 63k^2 + 36k$ **4.** $-5a(a - 1) = -5a^2 + 5a$ **5.** $2x^2(9 + x) = 18x^2 + 2x^3$
6. $-p^2(p - 11) = -p^3 + 11p^2$ **7.** $2x(6x^3 - x^2 + 5x) = (2 \cdot 6)x^{1+3} - 2x^{1+2} + (2 \cdot 5)x^{1+1} = 12x^4 - 2x^3 + 10x^2$ **8.** $4y^2(9y^3 + 8y^2 - 11) = 36y^{2+3} + 32y^{2+2} - 44y^2 = 36y^5 + 32y^4 - 44y^2$
9. $-5c^3(9c^2 - 8c - 5) = -45c^5 + 40c^4 + 25c^3$
10. $-7q^2(6q^5 - 2q - 7) = -42q^{2+5} + 14q^{2+1} + 49q^2 = -42q^7 + 14q^3 + 49q^2$ **11.** $-3g^7(g^4 - 6g^2 + 5) = -3g^{11} + 18g^9 - 15g^7$ **12.** $-4x^6(10x^3 + 3x^2 - 7) = -40x^9 - 12x^8 + 28x^6$ **13.** $15w + 21 = (3)5w + (3)7$; GCF $= 3$ **14.** $6a^2 - 8a = (2a)3a - (2a)4$; GCF $= 2a$

15. $36v + 24 = (12)3v + (12)2$; GCF $= 12$
16. $x^3 + 7x^2 - 5x = (x)x^2 + (x)7x - (x)5$; GCF $= x$
17. $5b^3 + 15b - 30 = (5)b^3 + (5)3b - (5)6$; GCF $= 5$
18. $9x^3 - 6x^2 + 12x = (3x)3x^2 - (3x)2x + (3x)4$; GCF $= 3x$ **19.** $6x - 4 = 2(3x - 2)$ **20.** $v^2 + 4v = v(v + 4)$ **21.** $10x^3 - 25x^2 + 20 = 5(2x^3 - 5x^2 + 4)$
22. $2t^2 - 10t^4 = 2t^2(1 - 5t^2)$ **23.** $15n^3 - 3n^2 + 12n = 3n(5n^2 - n + 4)$ **24.** $6p^6 + 24p^5 + 18p^3 = 6p^3(p^3 + 4p^2 + 3)$ **25.** Karla; Kevin wrote $-2x \cdot -3 = -6x$ instead of $+6x$. **26.** Answers may vary. Sample: $8x^3 + 12x^2 + 24x$; $4x(2x^2 + 3x + 6)$
27. $-3a(4a^2 - 5a + 9) = -12a^{1+2} + 15a^{1+1} - 27a = -12a^3 + 15a^2 - 27a$ **28.** $-7p^2(-2p^3 + 5p) = 14p^5 - 35p^3$ **29.** $12c(-5c^2 + 3c - 4) = -60c^3 + 36c^2 - 48c$ **30.** $y(y + 3) - 5y(y - 2) = y^2 + 3y - 5y^2 + 10y = -4y^2 + 13y$
31. $x^2(x + 1) - x(x^2 - 1) = x^3 + x^2 - x^3 + x = x^2 + x$ **32.** $4t(3t^2 - 4t) - t(7t) = 12t^3 - 16t^2 - 7t^2 = 12t^3 - 23t^2$ **33a.** $A = \pi(4x)^2 - (2x)^2 = 16\pi x^2 - 4x^2$ **33b.** $A = 4x^2(4\pi - 1)$
34. $9m^{12} - 36m^7 + 81m^5 = 9m^5(m^7 - 4m^2 + 9)$
35. $24x^3 - 96x^2 + 48x = 24x(x^2 - 4x + 2)$
36. $16n^3 + 48n^2 - 80n = 16n(n^2 + 3n - 5)$
37. $5x^4 + 4x^3 + 3x^2 = x^2(5x^2 + 4x + 3)$
38. $13ab^3 + 39a^2b^4 = 13ab^3(1 + 3ab)$
39. $7g^2k^3 - 35g^5k^2 = 7g^2k^2(k - 5g^3)$ **40.** 25; since p and q only have one 5 as a common factor, $p^2 = p \cdot p$ and $q^2 = q \cdot q$ only have $5 \cdot 5 = 25$ as a GCF.
41a. $n^2 - n = n(n - 1)$ **41b.** Always; the product of two consecutive integers is always even, since one of the integers is even. **42a.** $T(1) = \frac{1}{2}(1 + 1) = 1$; $T(2) = \frac{2}{2}(2 + 1) = 3$; $T(3) = \frac{3}{2}(3 + 1) = 6$; $T(4) = \frac{4}{2}(4 + 1) = 10$; the pattern shows that $T(n) = \frac{n}{2}(n + 1)$.
42b. $T(100) = \frac{100}{2}(100 + 1) = 5050$ **43a.** 6; 3
43b. $n - 3$; diagonals connect two nonconsecutive vertices. **43c.** $\frac{n}{2}(n - 3) = \frac{1}{2}n^2 - \frac{3}{2}n$ **43d.** $\frac{8}{2}(8 - 3) = 20$
44a. $V = (4s)^3 = 64s^3$ **44b.** $V = 48\pi s^2$ **44c.** $V = 64s^3 - 48\pi s^2 = 16s^2(4s - 3\pi)$ **44e.** $V = 16 \cdot 15^2(4 \cdot 15 - 3\pi) \approx 182{,}071$; about 182,071 in.^{3}
45. $x(6x^2 - 4x - 2) = 6x^3 - 4x^2 - 2x$; the answer is B.
46. $(p^2 - 3) - (5 - p + 2p^2) - (4p + 5 - 2p^2) = (1 - 2 + 2)p^2 + (1 - 4)p + (-3 - 5 - 5) = p^2 - 3p - 13$; the answer is F. **47.** $-24 = -24 \times 1 = -12 \times 2 = -8 \times 3 = -6 \times 4 = -4 \times 6 = -3 \times 8 = -2 \times 12 = -1 \times 24$; $\boxed{-24} = 8$; the answer is C. **48.** $2n$ must be even, so $2n + 1$ must be odd; the answer is G.
49. $6g^8 - 3g^4 + 9g^2 = 3g^2(2g^6 - g^2 + 3)$; the answer is B. **50.** [2] $10x^4 + 6x^3 + 2x^2 = 2x^2(5x^2 + 3x + 1)$; the terms $5x^2, 3x, 1$ have no common factor other than 1.
[1] incorrect factoring OR incorrect explanation
51. $(x^2 + 3) - (4x^2 - 7) = (1 - 4)x^2 + (3 + 7) = -3x^2 + 10$ **52.** $(m^3 + 8m + 6) + (-5m^2 + 4m) = m^3 - 5m^2 + 12m + 6$
53. $(g^2 + 6g - 2) + (4g^2 - 7g + 2) = (1 + 4)g^2 + (6 - 7)g = 5g^2 - g$
54. $(3r^2 - 8r + 7) - (2r^2 + 8r - 9) = r^2 - 16r + 16$
55. $(t^4 - t^3 + 1) + (t^3 + 5t^2 - 10) = t^4 + 5t^2 - 9$
56. $(3b^3 - b^2) - (5b^2 + 12) = 3b^3 - 6b^2 - 12$
57. $5^{-1} = \frac{1}{5}$ **58.** $5^{-2} = \frac{1}{5^2} = \frac{1}{25}$ **59.** $(-2)^{-3} = \frac{1}{(-2)^3} = -\frac{1}{8}$ **60.** $8^0 = 1$ **61.** $n^{-3}m^2 = \frac{m^2}{n^3}$ **62.** $v^3w^{-5} = \frac{v^3}{w^5}$
63. $\frac{4}{c^{-3}} = 4c^3$ **64.** $\frac{ab^{-8}}{c^5} = \frac{a}{b^8c^5}$

65.
$$\begin{aligned} 7x + 6y &= 33 \\ \underline{2x - 6y} &\underline{= -6} \\ 9x &= 27 \\ x &= 3 \\ 2 \cdot 3 - 6y &= -6 \\ -6y &= -12 \\ y &= 2 \end{aligned}$$

66.
$$\begin{aligned} 3x - 2y &= 21 \\ 6x - 4y &= 42 \\ \underline{8x + 4y} &\underline{= 28} \\ 14x &= 70 \\ x &= 5 \\ 3 \cdot 5 - 2y &= 21 \\ -2y &= 6 \\ y &= -3 \end{aligned}$$

67.
$$\begin{aligned} 4x + 2y &= 16 \\ 11x - 3y &= -7 \\ 12x + 6y &= 48 \\ \underline{22x - 6y} &\underline{= -14} \\ 34x &= 34 \\ x &= 1 \\ 4 \cdot 1 + 2y &= 16 \\ 2y &= 12 \\ y &= 6 \end{aligned}$$

INVESTIGATION *page 466*

1. $(x + 1)(x + 6) = x^2 + 7x + 6$ **2.** $(x + 1)(x - 2) = x^2 - x - 2$ **3.** $(x + 1)(4x - 1) = 4x^2 + 3x - 1$
4. $(x + 4)(2x + 1) = 2x^2 + 9x + 4$ **5.** $(x - 3)(3x + 5) = 3x^2 - 4x - 15$ **6.** $(2x + 3)(3x + 5) = 6x^2 + 19x + 15$

9-3 Multiplying Binomials *pages 467–473*

Check Skills You'll Need p. 467 For complete solutions see *Daily Skills Check and Lesson Quiz Transparencies* or *Presentation Pro CD-ROM.*

1. $4r^2 - r$ **2.** $6h^3 + 48h^2 - 18h$ **3.** $2y^5 - 7y^2$
4. $x^3 + 8x^2 + 2x + 1$ **5.** $8t^3 + t + 6$ **6.** $5w^2 - 27w$
7. $-2b^2 - 15b$ **8.** $7m^3 + 27m^2 - 6m$ **9.** $d^5 - 4d^3 - 18d^2$

Check Understanding 1a. $(6h - 7)(2h + 3) = 6h(2h + 3) - 7(2h + 3) = 12h^2 + 18h - 14h - 21 = 12h^2 + 4h - 21$ **1b.** $(5m + 2)(8m - 1) = 5m(8m - 1) + 2(8m - 1) = 40m^2 - 5m + 16m - 2 = 40m^2 + 11m - 2$ **1c.** $(9a - 8)(7a + 4) = 9a(7a + 4) - 8(7a + 4) = 63a^2 + 36a - 56a - 32 = 63a^2 - 20a - 32$ **2a.** $(3x + 4)(2x + 5) = (3x)(2x) + (3x)(5) + (4)(2x) + (4)(5) = 6x^2 + 15x + 8x + 20 = 6x^2 + 23x + 20$
2b. $(3x - 4)(2x + 5) = (3x)(2x) + (3x)(5) - (4)(2x) - (4)(5) = 6x^2 + 15x - 8x - 20 = 6x^2 + 7x - 20$

2c. $(3x + 4)(2x - 5) =$
$(3x)(2x) - (3x)(5) + (4)(2x) - (4)(5) =$
$6x^2 - 15x + 8x - 20 = 6x^2 - 7x - 20$
2d. $(3x - 4)(2x - 5) =$
$(3x)(2x) - (3x)(5) - (4)(2x) + (4)(5) =$
$6x^2 - 15x - 8x + 20 = 6x^2 - 23x + 20$
3a. $(5x + 8)(6x + 2) - 5x(x + 6) =$
$30x^2 + 10x + 48x + 16 - 5x^2 - 30x =$
$30x^2 - 5x^2 + 10x + 48x - 30x + 16 = 25x^2 + 28x + 16$
3b. $(x + 1)(2x - 2) - x(x - 2) =$
$2x^2 - 2x + 2x - 2 - x^2 + 2x = x^2 + 2x - 2$

4.
$$\begin{array}{r} 2n^2 + n + 7 \\ \times \quad 6n - 8 \\ \hline -16n^2 - 8n - 56 \\ 12n^3 + 6n^2 + 42n \quad\quad \\ \hline 12n^3 - 10n^2 + 34n - 56 \end{array}$$
; $(6n - 8)(2n^2 + n + 7) = 12n^3 + 6n^2 + 42n - 16n^2 - 8n - 56 = 12n^3 - 10n^2 + 34n - 56$

Exercises **1.** $(5a + 2)(6a - 1) = 30a^2 + 7a - 2$
2. $(3c - 7)(2c - 5) = 6c^2 - 29c + 35$ **3.** $(z - 4)(2z + 1) = 2z^2 - 7z - 4$ **4.** $(2x + 9)(x + 2) = 2x^2 + 13x + 18$
5. $(x + 2)(x + 5) = x(x + 5) + 2(x + 5) = x^2 + 5x + 2x + 10 = x^2 + 7x + 10$ **6.** $(h + 3)(h + 4) = h(h + 4) + 3(h + 4) = h^2 + 4h + 3h + 12 = h^2 + 7h + 12$ **7.** $(k + 7)(k - 6) = k(k - 6) + 7(k - 6) = k^2 - 6k + 7k - 42 = k^2 + k - 42$ **8.** $(a - 8)(a - 9) = a(a - 9) - 8(a - 9) = a^2 - 9a - 8a + 72 = a^2 - 17a + 72$
9. $(2x - 1)(x + 2) = 2x(x + 2) - (x + 2) = 2x^2 + 4x - x - 2 = 2x^2 + 3x - 2$ **10.** $(2y + 5)(y - 3) = 2y(y - 3) + 5(y - 3) = 2y^2 - 6y + 5y - 15 = 2y^2 - y - 15$ **11.** $(r + 6)(r - 4) = r^2 - 4r + 6r - 24 = r^2 + 2r - 24$ **12.** $(y + 4)(5y - 8) = 5y^2 - 8y + 20y - 32 = 5y^2 + 12y - 32$
13. $(x + 6)(x - 7) = x^2 - 7x + 6x - 42 = x^2 - x - 42$
14. $(m - 6)(m - 9) = m^2 - 9m - 6m + 54 = m^2 - 15m + 54$ **15.** $(4b - 2)(b + 3) = 4b^2 + 12b - 2b - 6 = 4b^2 + 10b - 6$
16. $(8w + 2)(w + 5) = 8w^2 + 40w + 2w + 10 = 8w^2 + 42w + 10$ **17.** $(x - 7)(x + 9) = x^2 + 9x - 7x - 63 = x^2 + 2x - 63$ **18.** $(a + 11)(a + 5) = a^2 + 5a + 11a + 55 = a^2 + 16a + 55$
19. $(p - 1)(p + 10) = p^2 + 10p - p - 10 = p^2 + 9p - 10$ **20.** $(x + 3)(x + 2) - x(x - 3) = x^2 + 5x + 6 - x^2 + 3x = 8x + 6$
21. $(x + 8)(x + 6) - 3x(x + 3) = x^2 + 14x + 48 - 3x^2 - 9x = -2x^2 + 5x + 48$

22.
$$\begin{array}{r} x^2 - 4x + 1 \\ \times \quad x + 9 \\ \hline 9x^2 - 36x + 9 \\ x^3 - 4x^2 + x \quad\quad \\ \hline x^3 + 5x^2 - 35x + 9 \end{array}$$

23.
$$\begin{array}{r} a^2 - 2a + 1 \\ \times \quad a - 4 \\ \hline -4a^2 + 8a - 4 \\ a^3 - 2a^2 + a \quad\quad \\ \hline a^3 - 6a^2 + 9a - 4 \end{array}$$

24.
$$\begin{array}{r} 2g^2 + 3g + 3 \\ \times \quad g - 3 \\ \hline -6g^2 - 9g - 9 \\ 2g^3 + 3g^2 + 3g \quad\quad \\ \hline 2g^3 - 3g^2 - 6g - 9 \end{array}$$

25.
$$\begin{array}{r} 3k^2 - 5k + 7 \\ \times \quad k + 8 \\ \hline 24k^2 - 40k + 56 \\ 3k^3 - 5k^2 + 7k \quad\quad \\ \hline 3k^3 + 19k^2 - 33k + 56 \end{array}$$

26. $(9x - 3)(x^2 + 2x + 1) = 9x^3 + 18x^2 + 9x - 3x^2 - 6x - 3 = 9x^3 + 15x^2 + 3x - 3$
27. $(2t - 5)(t^2 - 6t + 3) = 2t^3 - 12t^2 + 6t - 5t^2 + 30t - 15 = 2t^3 - 17t^2 + 36t - 15$ **28.** $(8p + 9)(7p^2 + 5p - 1) = 56p^3 + 40p^2 - 8p + 63p^2 + 45p - 9 = 56p^3 + 103p^2 + 37p - 9$ **29.** $(4w - 2)(12w^2 - w - 1) = 48w^3 - 4w^2 - 4w - 24w^2 + 2w + 2 = 48w^3 - 28w^2 - 2w + 2$ **30.** $(p - 7)(p + 8) = p^2 + 8p - 7p + 56 = p^2 + p + 56$
31. $(-7 + p)(8 + p) = -56 - 7p + 8p + p^2 = p^2 + p - 56$ **32.** $(p^2 - 7)(p + 8) = p^3 + 8p^2 - 7p - 56$
33. $(5c - 9)(5c + 1) = 25c^2 + 5c - 45c - 9 = 25c^2 - 40c - 9$ **34.** $(n^2 + 3)(n + 11) = n^3 + 11n^2 + 3n + 33$ **35.** $(3k^2 + 2)(5k^2 + k) = 15k^4 + 3k^3 + 10k^2 + 2k$ **36.** $(6h - 1)(4h^2 + h + 3) = 24h^3 + 6h^2 + 18h - 4h^2 - h - 3 = 24h^3 + 2h^2 + 17h - 3$
37. $(9y^2 + 2)(y^2 - y - 1) = 9y^4 - 9y^3 - 9y^2 + 2y^2 - 2y - 2 = 9y^4 - 9y^3 - 7y^2 - 2y - 2$ **38.** $(8q - 4)(6q^2 + q + 1) = 48q^3 + 8q^2 + 8q - 24q^2 - 4q - 4 = 48q^3 - 16q^2 + 4q - 4$ **39a.** Let x = width of garden. Area of garden $= x(2x) = 2x^2$. Area of garden and walk $= (x + 4)(2x + 4) = 2x^2 + 12x + 16$. **39b.** Area of walk only $= (2x^2 + 12x + 16) - 2x^2 = 12x + 16$.

39c.
$$\begin{aligned} 12x + 16 &= 76 \\ 12x &= 60 \\ x &= 5 \end{aligned}$$
Garden should be 5 ft by 10 ft.

40. Answers may vary. Sample: $(x + 2)(x^2 + 3x + 4) = x^3 + 3x^2 + 4x + 2x^2 + 6x + 8 = x^3 + 5x^2 + 10x + 8$

41. Answers may vary. Sample: vertical method, in which the terms are aligned
42. $0.5(x + 6)(2x + 5) - x(x + 1) = 0.5(2x^2 + 17x + 30) - x^2 - x = x^2 + 8.5x + 15 - x^2 - x = 7.5x + 15$
43. $0.5(x + 2x - 1)(x + 2) = 0.5(3x - 1)(x + 2) = 0.5(3x^2 + 5x - 2) = 1.5x^2 + 2.5x - 1$

44a.i. $(x + 1)(x + 1) = x^2 + 2x + 1; 11 \cdot 11 = 121$
ii. $(x + 1)(x + 2) = x^2 + 3x + 2; 11 \cdot 12 = 132$
iii. $(x + 1)(x + 3) = x^2 + 4x + 3; 11 \cdot 13 = 143$
44b. The two problems in each case are identical if $x = 10$. In the result $ax^2 + bx + c$, a corresponds to the hundreds digit, b to the tens digit, and c to the ones digit.
45. $V = (n + 7)(n)(n + 8) = (n + 7)(n^2 + 8n) = n^3 + 15n^2 + 56n$ **46.** $(n + 2)(n + 4) = n^2 + 6n + 8$

47. $6(x+3)(x+3) = 6(x^2+6x+9) = 6x^2+36x+54$
48. $6(4t+1)(4t+1) = 6(16t^2+8t+1) = 96t^2+48t+6$
49. $6(2w^2+7)(2w^2+7) = 6(4w^4+28w^2+49) =$
$24w^4+168w^2+294$ **50a.** $V(t) = C(t)\cdot P(t) =$
$(2.7t+165)(2.6t+248) = 7.02t^2+1098.6t+40{,}920$
50b. $V(5) = 7.02\cdot 5^2+1098.6\cdot 5+40{,}920 = 46{,}588.5$;
about 46,588,500,000 lb
51a. $2000(1+r)(1+r)(1+r) =$
$2000(1+r)(1+2r+r^2) =$
$2000(1+2r+r^2+r+2r^2+r^3) =$
$2000(1+3r+3r^2+r^3) =$
$2000r^3+6000r^2+6000r+2000$ **51b.** $2000(1.03)^3 =$
$2000\cdot 1.092727 \approx 2185.45$; \$2185.45 **52.** $\pi(g+2)^2 =$
$\pi g^2+4\pi g+4\pi$ **53.** $\pi(4k+5)^2 = \pi(4k+5)(4k+5) =$
$\pi(16k^2+40k+25) = 16\pi k^2+40\pi k+25\pi$
54. $\pi(3x+1)(3x+1) = \pi(9x^2+6x+1) =$
$9\pi x^2+6\pi x+\pi$ **55.** $14\cdot 72 = 1008$ **56.** $53\cdot 87 =$
4611 **57.** $91\cdot 64 = 5824$ **58.** $38\cdot 64 = 2432$
59. $(n-1)(n-4) = n^2-5n+4$; the answer is A.
60. $(8k-3)(k^2-k+1) =$
$8k^3-8k^2+8k-3k^2+3k-3 =$
$8k^3-11k^2+11k-3$; the answer is H. **61. A.** even if n is odd **B.** $(2n-1)(2n+1) = 4n^2-1$; $4n^2$ is even so $4n^2$ is odd **C.** $(2n-1)(n+1) = 2n^2+n-1$ is even if n is odd **D.** $(2n+1)(n-1) = 2n^2-n-1$ is even if n is odd; the answer is B. **62.** [2] Multiply each term in the trinomial by $4v$, and then each original term by -1; add the 6 products. $(4v-1)(2v^2+v+1) =$
$8v^3+4v^2+4v-2v^2-v-1 = 8v^3+2v^2+3v-1$
[1] incorrect calculation OR incorrect explanation
63. [4] $(2n-2)(2n+6)-(n+2)(3n+2) =$
$10n^2+30n-4n-12-3n^2-2n-6n-4 =$
$7n^2+18n-16$ [3] one computational error
[2] incorrect products subtracted correctly OR correct products subtracted incorrectly [1] no work shown
64. $4v(5v-7) = 20v^2-28v$ **65.** $(c-9)3c = 3c^2-27c$
66. $8t^2(t+6) = 8t^3+48t^2$ **67.** $y(3y-10) = 3y^2-10y$
68. $5x^2(11-x) = -5x^3+55x^2$ **69.** $-t^3(6t-1) =$
$-6t^4+t^3$ **70.** $4r(3-r^5) = -4r^6+12r$ **71.** $9b^2(b^3+2b) =$
$9b^5+18b^3$ **72.** $5w+45 = 5(w+9)$ **73.** $3x^2-11x =$
$x(3x-11)$ **74.** $4a^2+12a = 4a(a+3)$ **75.** $9n^2-n^3 =$
$n^2(9-n)$ **76.** $34t-51 = 17(2t-3)$ **77.** $63v^2+45v =$
$9v(7v+5)$ **78.** $25m-60m^3 = 5m(5-12m^2)$
79. $11k+77k^6 = 11k(1+7k^5)$
80. $\frac{3^5}{3^2} = 3^{5-2} = 3^3 = 27$ **81.** $\frac{3^2}{3^5} = \frac{1}{3^3} = \frac{1}{27}$
82. $\frac{y^{12}}{y^8} = y^4$ **83.** $\frac{2w^{-3}}{6w^2} = \frac{1}{3w^5}$ **84.** $\frac{x^{-8}}{2x^3} = \frac{1}{2x^{11}}$
85. $\left(\frac{5}{3}\right)^{-1} = \frac{3}{5}$ **86.** $\left(\frac{5}{3}\right)^{-2} = \left(\frac{3}{5}\right)^2 = \frac{3^2}{5^2} = \frac{9}{25}$
87. $\left(\frac{5}{3}\right)^0 = 1$ **88.** $\left(\frac{4x}{7}\right)^{-2} = \left(\frac{7}{4x}\right)^2 = \frac{7^2}{4^2x^2} = \frac{49}{16x^2}$
89. $\left(\frac{y^{-2}}{8}\right)^{-2} = \left(\frac{8}{y^{-2}}\right)^2 = (8y^2)^2 = 64y^4$

CHECKPOINT QUIZ 1 *page 472*

1. $(4x^2+x+3)+(5x^2+9x-2) = 9x^2+10x+1$
2. $(7b^2-5b+3)-(b^2+8b-6) = 6b^2-13b+9$
3. $(g^2+4)(4g^2+8g-9) =$
$4g^4+8g^3-9g^2+16g^2+32g-36 =$
$4g^4+8g^3+7g^2+32g-36$
4. $6k(4k+k^2)+9k(2k-6k^2) =$
$24k^2+6k^3+18k^2-54k^3 =$
$-48k^3+42k^2$ **5.** $(x+3)(x-5) =$
$x^2-2x-15$ **6.** $(2n^3-5)(6n^2+n) =$
$12n^5+2n^4-30n^2-5n$ **7.** $3w(12w-1)-8w =$
$36w^2-3w-8w = 36w^2-11w$ **8.** $12y^2-10 =$
$2(6y^2-5)$ **9.** $5t^6+25t^3-10t = 5t(t^5+5t^2-2)$
10. $18v^4+27v^3+36v^2 = 9v^2(2v^2+3v+4)$

READING MATH *page 473*

Total area of outer box − area of white box =
$(x+4)(x+4)-x(x+1) =$
$x^2+4x+4x+16-x^2-x = 7x+16.$

9-4 Multiplying Special Cases *pages 474–479*

Check Skills You'll Need p. 474 For complete solutions see *Daily Skills Check and Lesson Quiz Transparencies* or *Presentation Pro CD-ROM.*
1. $49x^2$ **2.** $9v^2$ **3.** $16c^2$ **4.** $25g^6$ **5.** $j^2+12j+35$
6. $6b^2-34b+48$ **7.** $20y^2-3y-2$ **8.** x^2-x-12
9. $8c^4-78c^2-20$ **10.** $54y^4-21y^2-3$
Investigation 1. Row 1: $(x+8)(x+8) =$
$x^2+8x+8x+64 = x^2+16x+64$; $(y+5)(y+5) =$
$y^2+10y+25$; $(2p+3)(2p+3) = 4p^2+12p+9$;
Row 2: $(d-3)(d-3) = d^2-3d-3d+9 =$
d^2-6d+9; $(t-1)(t-1) = t^2-2t+1$;
$(9r-2)(9r-2) = 81r^2-36r+4$; Row 3:
$(x+4)(x-4) = x^2-4x+4x-16 =$
x^2-16; $(k+9)(k-9) = k^2-81$; $(3c+7)(3c-7) =$
$9c^2-49$ **2.** Row 1: $(a+b)(a+b) = a^2+2(ab)+b^2$;
Row 2: $(a-b)(a-b) = a^2-2(ab)+b^2$; Row 3:
$(a+b)(a-b) = a^2-b^2$ **3.** $(p+6)(p+6) =$
$p^2+2(6p)+6^2 = p^2+12p+36$; $(v-5)(v-5) =$
$v^2-2(5v)+5^2 = v^2-10v+25$; $(x+8)(x-8) =$
$x^2-8^2 = x^2-64$ **4.** yes
Check Understanding 1a. $(t+6)^2 = t^2+2t(6)+6^2 =$
$t^2+12t+36$ **1b.** $(5y+1)^2 = (5y)^2+2(5y)+1 =$
$25y^2+10y+1$ **1c.** $(7m-2p) =$
$(7m)^2-2(7m)(2p)+(2p)^2 = 49m^2-28mp+4p^2$
1d. $(9c-8)^2 = (9c)^2-2(9c)(8)+8^2 =$
$81c^2-144c+64$ **2a.** $\left(\frac{1}{3}A+\frac{2}{3}B\right)^2 = \left(\frac{1}{3}A\right)^2+$
$+2\left(\frac{1}{3}A\right)\left(\frac{2}{3}B\right)+\left(\frac{2}{3}B\right)^2 = \frac{1}{9}A^2+\frac{4}{9}AB+\frac{4}{9}B^2$
2b. $P(AA) = \frac{1}{9}$ **2c.** $P(AB) = \frac{4}{9}$ **2d.** $P(BB) = \frac{4}{9}$
3a. $31^2 = (30+1)^2 = 30^2+2(30)+1 =$
$900+60+1 = 961$ **3b.** $29^2 = (30-1)^2 =$
$30^2-2(30)+1 = 900-60+1 = 841$ **3c.** $98^2 =$
$(100-2)^2 = 100^2-2(100)2+4 = 10{,}000-400+4 =$
9604 **3d.** $203^2 = (200+3)^2 = 200^2+6(200)+3^2 =$
$40{,}000+1200+9 = 41{,}209$ **4a.** $(d+11)(d-11) =$
$d^2-11^2 = d^2-121$ **4b.** $(c^2+8)(c^2-8) =$

$(c^2)^2 - 8^2 = c^4 - 64$ **4c.** $(9v^3 + w^4)(9v^3 - w^4) = (9v^3)^2 - (w^4)^2 = 81v^6 - w^8$ **5a.** $18 \cdot 22 = (20 - 2)(20 + 2) = 400 - 4 = 396$
5b. $19 \cdot 21 = (20 - 1)(20 + 1) = 400 - 1 = 399$
5c. $59 \cdot 61 = (60 - 1)(60 + 1) = 3600 - 1 = 3599$
5d. $87 \cdot 93 = (90 - 3)(90 + 3) = 8100 - 9 = 8091$

Exercises **1.** $(c + 1)^2 = c^2 + 2c + 1$ **2.** $(x + 4)^2 = x^2 + 2(4x) + 4^2 = x^2 + 8x + 16$ **3.** $(2v + 11)^2 = (2v)^2 + 2(2v)11 + 11^2 = 4v^2 + 44v + 121$
4. $(3m + 7)^2 = (3m)^2 + 2(3m)7 + 7^2 = 9m^2 + 42m + 49$
5. $(w - 12)^2 = w^2 - 24w + 144$ **6.** $(b - 5)^2 = b^2 - 10b + 25$ **7.** $(6x - 8)^2 = (6x)^2 - 2(6x)8 + 8^2 = 36x^2 - 96x + 64$ **8.** $(9j - 2)^2 = 81j^2 - 36j + 4$
9a. $\left(\frac{1}{4}C + \frac{3}{4}D\right)^2 = \left(\frac{1}{4}C\right)^2 + 2\left(\frac{1}{4}C\right)\left(\frac{3}{4}D\right) + \left(\frac{3}{4}D\right)^2 = \frac{1}{16}C^2 + \frac{3}{8}CD + \frac{9}{16}D^2$ **9b.** $P(CC) = P(1)P(1) = \frac{1}{4} \cdot \frac{1}{4} = \frac{1}{16}$ **9c.** It is the coefficient of C^2.
10. $61^2 = (60 + 1)^2 = 3600 + 120 + 1 = 3721$
11. $99^2 = (100 - 1)^2 = 10{,}000 - 200 + 1 = 9801$
12. $48^2 = (50 - 2)^2 = 2500 - 200 + 4 = 2304$
13. $302^2 = (300 + 2)^2 = 90{,}000 + 1200 + 4 = 91{,}204$
14. $499^2 = (500 - 1)^2 = 250{,}000 - 1000 + 1 = 249{,}001$
15. $(x + 4)(x - 4) = x^2 - 4x + 4x - 4^2 = x^2 - 16$
16. $(a + 8)(a - 8) = a^2 - 64$ **17.** $(d + 7)(d - 7) = d^2 - 49$ **18.** $(h + 15)(h - 15) = h^2 - 225$
19. $(y + 12)(y - 12) = y^2 - 144$ **20.** $(k + 5)(k - 5) = k^2 - 25$ **21.** $31 \cdot 29 = (30 + 1)(30 - 1) = 900 - 1 = 899$
22. $89 \cdot 91 = (90 - 1)(90 + 1) = 8100 - 1 = 8099$
23. $52 \cdot 48 = (50 + 2)(50 - 2) = 2500 - 4 = 2496$
24. $197 \cdot 203 = (200 - 3)(200 + 3) = 40{,}000 - 9 = 39{,}991$ **25.** $299 \cdot 301 = (300 - 1)(300 + 1) = 90{,}000 - 1 = 89{,}999$ **26.** $(x + 3)^2 - x^2 = x^2 + 6x + 9 - x^2 = 6x + 9$; $(6x + 9)$ units^2
27. $(x + 4)^2 - (x - 1)^2 = x^2 + 8x + 16 - (x^2 - 2x + 1) = 10x - 15$; $(10x - 15)$ units^2 **28.** $(x + 3y)^2 = x^2 + 2(3xy) + (3y)^2 = x^2 + 6xy + 9y^2$ **29.** $(5p - 9)^2 = (5p)^2 - 2(5p)q + q^2 = 25p^2 - 10pq + q^2$ **30.** $(6m + n)^2 = 36m^2 + 12mn + n^2$ **31.** $(x - 7y)^2 = x^2 - 14xy + 49y^2$
32. $(4k + 7j)^2 = 16k^2 + 56kj + 49j^2$ **33.** $(2y - 9x)^2 = 4y^2 - 36xy + 81x^2$ **34.** $(3w + 10t)^2 = 9w + 60wt + 100t^2$
35. $(6a + 11b)^2 = 36a^2 + 132ab + 121b^2$ **36.** $(5p - 6q)^2 = 25p^2 - 60pq + 36q^2$ **37.** $(6h - 8p)^2 = 36h^2 - 96hp + 64p^2$ **38.** $(y^5 - 9x^4)^2 = y^{10} - 18x^4y^5 + 81x^8$ **39.** $(8k + 4h)^2 = 64k^2 + 64kh + 16h^2$
40a. $\left(\frac{1}{2}R + \frac{1}{2}W\right)^2 = \frac{1}{4}R^2 + \frac{1}{2}RW + \frac{1}{4}W^2$ **40b.** $\frac{1}{2}$
40c. $\left(\frac{1}{2}R + \frac{1}{2}W\right)(R) = \frac{1}{2}R^2 + \frac{1}{2}RW$ **40d.** 0

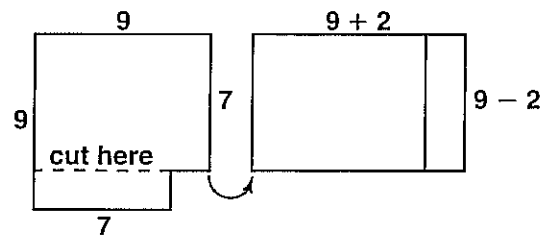
41a.

$4^2 = 16$	$3 \cdot 5 = 15$
$5^2 = 25$	$4 \cdot 6 = 24$
$6^2 = 36$	$5 \cdot 7 = 35$
$7^2 = 49$	$6 \cdot 8 = 48$

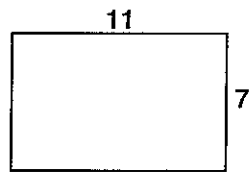
41b. n^2 is one more than the product $(n - 1)(n + 1)$. **41c.** The product $(n - 1)(n + 1)$ is $n^2 - 1$.
42. Answers may vary. $(x + y)^2 = x^2 + 2xy + y^2$, so any example where $x \neq 0$ and $y \neq 0$ will suffice.
43 No; $\left(3\frac{1}{2}\right)^2 = \left(3 + \frac{1}{2}\right)^2 = 3^2 + 2 \cdot 3 \cdot \frac{1}{2} + \left(\frac{1}{2}\right)^2 = 9 + 3 + \frac{1}{4} = 12\frac{1}{4}$; the example omitted the middle term.

44. $(3y + 5w)(3y - 5w) = (3y)^2 - (3y)(5w) + (3y)(5w) + (5w)^2 = 9y^2 - 25w^2$
45. $(p + 9q)(p - 9q) = p^2 - 81q^2$
46. $(2d + 7g)(2d - 7g) = 4d^2 - 49g^2$
47. $(7b - 8c)(7b + 8c) = 49b^2 - 64c^2$
48. $(g + 7h)(g - 7h) = g^2 - 49h^2$
49. $(g^3 + 7h^2)(g^3 - 7h^2) = g^6 - 49h^4$
50. $(2a^2 + b)(2a^2 - b) = 4a^4 - b^2$
51. $(11x - y^3)(11x + y^3) = 121x^2 - y^6$
52. $(4k - 3h^2)(4k + 3h^2) = 16k^2 - 9h^4$
53. $(a + b + c)^2 = (a + b + c)(a + b + c) = a^2 + ab + ac + ba + b^2 + bc + ca + cb + c^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ac$ **54a.** $\left(\frac{1}{2}H + \frac{1}{2}T\right)^3 = \left(\frac{1}{2}H + \frac{1}{2}T\right)\left(\frac{1}{2}H + \frac{1}{2}T\right)\left(\frac{1}{2}H + \frac{1}{2}T\right) = \left(\frac{1}{2}H + \frac{1}{2}T\right)\left(\frac{1}{4}H^2 + \frac{1}{2}HT + \frac{1}{4}T^2\right) = \frac{1}{8}H^3 + \frac{1}{4}H^2T + \frac{1}{8}HT^2 + \frac{1}{8}H^2T + \frac{1}{4}HT^2 + \frac{1}{8}T^3 = \frac{1}{8}H^3 + \frac{3}{8}H^2T + \frac{3}{8}HT^2 + \frac{1}{8}T^3$ **54b.** $P(HT^2) = \frac{3}{8}$
55a. $m = 3n + 1$; $m^2 = (3n + 1)^2 = 9n^2 + 6n + 1 = 3(3n^2 + 2n) + 1 = (\text{multiple of } 3) + 1$
55b. no; $(3n + 2)^2 = 9n^2 + 12n + 4 = 3(3n^2 + 4n + 1) + 1 = (\text{multiple of } 3) + 1$ **56.** $V = \frac{4}{3}\pi(r + 3)^3 = \frac{4}{3}\pi(r + 3)(r + 3)(r + 3) = \frac{4}{3}\pi(r + 3)(r^2 + 6r + 9) = \frac{4}{3}\pi(r^3 + 6r^2 + 9r + 3r^2 + 18r + 27) = \frac{4}{3}\pi(r^3 + 9r^2 + 27r + 27) = \frac{4}{3}\pi r^3 + 12\pi r^2 + 36\pi r + 36\pi$

57a.



57b.



58. $(9x - 1)^2 = 81x^2 - 18x + 1$; the answer is D.
59. $(b^7 + 2)^2 = b^{14} + 4b^7 + 4$; the answer is F.
60. A. $(3a - 10)(3a + 10) = 9a^2 - 100$
B. $(9b - 10)(b - 10) = 9b^2 - 100b + 100$; the answer is C. **61. A.** $(4a - 6)(5a + 1) = 20a^2 - 26a - 6$
B. $(8b - 7)(3b + 9) = 24b^2 + 51b - 63$; the answer is B.
62. A. $(7a + 3)(8a + 2) = 56a^2 + 38a + 6$
B. $(12b - 1)(b - 6) = 12b^2 - 73b + 6$; the answer is C.
63. [2] The middle term is twice the product of the first and last terms; $2(3x)(-4y) = -24xy$.
64. $(k + 7)(k - 9) = k^2 - 9k + 7k - 63 = k^2 - 2k - 63$ **65.** $(2x - 11)(x - 6) = 2x^2 - 23x + 66$
66. $(5p + 4)(3p - 1) = 15p^2 + 7p - 4$
67. $(3y + 1)(y + 1) = 3y^2 + 4y + 1$
68. $(4h - 2)(6h + 1) = 24h^2 - 8h - 2$
69. $(9b + 7)(8b + 2) = 72b^2 + 74b + 14$
70. $(2w^2 + 5)(w + 8) = 2w^3 + 16w^2 + 5w + 40$

71. $(r - 7)(r^2 + 3r - 9) =$
$r^3 + 3r^2 - 9r - 7r^2 - 21r + 63 = r^3 - 4r^2 - 30r + 63$
72. $(5m^2 - 2)(6m^3 + 4m) = 30m^5 + 8m^3 - 8m$
73. $8713 = 8.713 \times 10^3$ **74.** $0.031 = 3.1 \times 10^{-2}$
75. $68{,}952 = 6.8952 \times 10^4$ **76.** 1.2 million $= 1.2 \times 10^6$
77. $11 = 1.1 \times 10^1$ **78.** $523 = 5.23 \times 10^2$ **79.** 6 billion $= 6 \times 10^9$ **80.** $0.72 = 7.2 \times 10^{-1}$

INVESTIGATION *page 480*

1. $x^2 + 8x + 15 = (x + 3)(x + 5)$ **2.** $x^2 + 4x + 4 = (x + 2)(x + 2)$ **3.** $x^2 + 8x + 7 = (x + 7)(x + 1)$
4. $2x^2 + 7x + 3 = (2x + 1)(x + 3)$ **5.** $4x^2 + 12x + 5 = (2x + 5)(2x + 1)$ **6.** $6x^2 + 7x + 2 = (3x + 2)(2x + 1)$
7. $x^2 + 3x + 5$ cannot be written as a product of two binomials. **8.** ■ $= 7, (2x + 3)(x + 2)$;
■ $= 8, (2x + 2)(x + 3)$ or $(2x + 6)(x + 1)$;
■ $= 13, (2x + 1)(x + 6)$

9-5 Factoring Trinomials of the Type $x^2 + bx + c$ *pages 481–485*

Check Skills You'll Need p. 481 For complete solutions see *Daily Skills Check and Lesson Quiz Transparencies* or *Presentation Pro CD-ROM.*

1. 1, 2, 3, 4, 6, 8, 12, 24 **2.** 1, 2, 3, 4, 6 12 **3.** 1, 2, 3, 6, 9, 18, 27, 54 **4.** 1, 3, 5, 15 **5.** 1, 2, 3, 4, 6, 9, 12, 18, 36 **6.** 1, 2, 4, 7, 8, 14, 28, 56 **7.** 1, 2, 4, 8, 16, 32, 64 **8.** 1, 2, 3, 4, 6, 8, 12, 16, 24, 32, 48, 96

Check Understanding 1a. $10 = 1 \cdot 10 = 2 \cdot 5$; $2 + 5 = 7$; check: $(g + 2)(g + 5) = g^2 + 5g + 2g + 10 = g^2 + 7g + 10$ ✓
1b. $20 = 1 \cdot 20 = 2 \cdot 10 = 4 \cdot 5; 1 + 20 = 21$; check: $(v + 1)(v + 20) = v^2 + 20v + v + 20 = v^2 + 21v + 20$ ✓
1c. $30 = 1 \cdot 30 = 2 \cdot 15 = 3 \cdot 10 = 5 \cdot 6; 3 + 10 = 13$; check: $(a + 3)(a + 10) = a^2 + 10a + 3a + 30 = a^2 + 13a + 30$ ✓
2a. $25 = -1 \cdot -25 = -5 \cdot -5; -5 + (-5) = -10$; check: $(k - 5)(k - 5) = k^2 - 5k - 5k + 25 = k^2 - 10k + 25$ ✓
2b. $18 = -1 \cdot -18 = -2 \cdot -9 = -3 \cdot -6; -2 + (-9) = -11$; check: $(x - 2)(x - 9) = x - 11 + 18$ ✓
2c. $36 = -1 \cdot -36 = -2 \cdot -18 = -3 \cdot -12 = -4 \cdot -9 = -6 \cdot -6; -3 + (-12) = -15$; check: $(q - 3)(q - 12) = q^2 - 15q + 36$ ✓
3a. $-20 = -1 \cdot 20 = 1 \cdot -20 = -2 \cdot 10 = 2 \cdot -10 = -4 \cdot 5 = 4 \cdot -5; -2 + 10 = 8$; check: $(m - 2)(m + 10) = m^2 + 10m - 2m - 20 = m^2 + 8m - 20$ ✓
3b. $-40 = -1 \cdot 40 = 1 \cdot -40 = -2 \cdot 20 = 2 \cdot -20 = -4 \cdot 10 = 4 \cdot -10 = -5 \cdot 8 = 5 \cdot -8; 5 + (-8) = -3$; check: $(p + 5)(p - 8) = p^2 - 3p - 40$ ✓
3c. $-56 = -1 \cdot 56 = 1 \cdot -56 = -2 \cdot 28 = 2 \cdot -28 = -4 \cdot 14 = 4 \cdot -14 = -7 \cdot 8 = 7 \cdot -8; 7 + (-8) = -1$; check: $(y + 7)(y - 8) = y^2 - y - 56$ ✓
4a. $24 = 1 \cdot 24 = 2 \cdot 12 = 3 \cdot 8 = 4 \cdot 6; 3 + 8 = 11$; check: $(x + 3y)(x + 8y) = x^2 + 11xy + 24y^2$ ✓
4b. $-48 = -1 \cdot 48 = 1 \cdot 48 = -2 \cdot 24 = 2 \cdot -24 = -3 \cdot 16 = 3 \cdot -16 = -4 \cdot 12 = 4 \cdot -12 = -6 \cdot 8 = 6 \cdot -8; -6 + 8 = 2$; check: $(v - 6w)(v + 8w) = v^2 + 2vw - 48w^2$ ✓
4c. $-60 = -1 \cdot 60 = 1 \cdot -60 = -2 \cdot 30 = 2 \cdot -30 = -3 \cdot 20 = 3 \cdot -20 = -4 \cdot 15 = 4 \cdot -15 = -6 \cdot 10 = 6 \cdot -10; 3 + (-20) = -17$; check: $(m + 3n)(m - 20n) = m^2 - 17mn - 60n^2$ ✓

Exercises 5. $3 \cdot 1 = 3; 3 + 1 = 4; r^2 + 4r + 3 = (r + 3)(r + 1)$ **6.** $-2 \cdot -1 = 2; -2 + (-1) = -3; n^2 - 3n + 2 = (n - 2)(n - 1)$ **7.** $3 \cdot 2 = 6; 3 + 2 = 5; k^2 + 5k + 6 = (k + 3)(k + 2)$ **8.** $4 \cdot 2 = 8; 4 + 2 = 6; y^2 + 6y + 8 = (y + 4)(y + 2)$ **9.** $-1 \cdot -1 = 1; -1 + (-1) = -2; x^2 - 2x + 1 = (x - 1)(x - 1)$
10. $18 \cdot 1 = 18; 18 + 1 = 19; p^2 + 19p + 18 = (p + 18)(p + 1)$ **11.** $-2 \cdot -14 = 28; -2 + (-14) = -16; k^2 - 16k + 28 = (k - 2)(k - 14)$ **12.** $5 \cdot 1 = 6; 5 + 1 = 6; w^2 + 6w + 5 = (w + 5)(w + 1)$
13. $-8 \cdot -1 = 8; -8 + (-1) = -9; m^2 - 9m + 8 = (m - 8)(m - 1)$ **14.** $2 \cdot 19 = 38; 2 + 19 = 21; d^2 + 21d + 38 = (d + 2)(d + 19)$ **15.** $-6 \cdot -7 = 42; -6 + -7 = -13; t^2 - 13t + 42 = (t - 6)(t - 7)$
16. $-3 \cdot -15 = 45; -3 + (-15) = -18; q^2 - 18q + 45 = (q - 3)(q - 15)$ **17.** $m^2 + 3m - 10 = (m - 2)(m + 5)$
18. $v^2 - 2v - 24 = (v + 4)(v - 6)$ **19.** $k^2 - 8k - 9 = (k + 1)(k - 9)$ **20.** $q^2 + 3q - 18 = (q - 3)(q + 6)$
21. $-1 \cdot 4 = -4; -1 + 4 = 3; x^2 + 3x - 4 = (x - 1)(x + 4)$ **22.** $-4 \cdot 2 = -8; -4 + 2 = -2; q^2 - 2q - 8 = (q - 4)(q + 2)$ **23.** $-4 \cdot 5 = -20; -4 + 5 = -1; y^2 + y - 20 = (y - 4)(y + 5)$
24. $-1 \cdot 17 = -17; -1 + 17 = 16; h^2 + 16h - 17 = (h - 1)(h + 17)$ **25.** $-16 \cdot 2 = -32; -16 + 2 = -14; x^2 - 14x - 32 = (x - 16)(x + 2)$ **26.** $-4 \cdot 10 = -40; -4 + 10 = 6; d^2 + 6d - 40 = (d - 4)(d + 10)$
27. $-15 \cdot 2 = -30; -15 + 2 = -13; m^2 - 13m - 30 = (m - 15)(m + 2)$ **28.** $-6 \cdot 9 = -54; -6 + 9 = 3; p^2 + 3p - 54 = (p - 6)(p + 9)$ **29.** $-18 \cdot 3 = -54; -18 + 3 = -15; p^2 - 15p - 54 = (p - 18)(p + 3)$
30. A **31.** B **32.** B **33.** $-2 \cdot 9 = -18; -2 + 9 = 7; t^2 + 7tv - 18v^2 = (t - 2v)(t + 9v)$ **34.** $7 \cdot 5 = 35; 7 + 5 = 12; x^2 + 12xy + 35y^2 = (x + 7y)(x + 5y)$
35. $-8 \cdot -2 = 16; -8 + (-2) = -10; p^2 - 10pq + 16q^2 = (p - 8q)(p - 2q)$ **36.** $-9 \cdot 6 = -54; -9 + 6 = -3; m^2 - 3mn - 54n^2 = (m - 9n)(m + 6n)$ **37.** $17 \cdot 1 = 17; 17 + 1 = 18; h^2 + 18hj + 17j^2 = (h + 17j)(h + j)$
38. $-13 \cdot 3 = -39; -13 + 3 = -10; x^2 - 10xy - 39y^2 = (x - 13y)(x + 3y)$ **39–40.** Answers may vary. Samples are given.

39. $(x + 2)(x - 5)$; ■ $= 10$
$(x + 3)(x - 6)$; ■ $= 18$
$(x + 4)(x - 7)$; ■ $= 28$

40. $(x - 1)(x + 2)$; ■ $= 2$
$(x - 3)(x + 4)$; ■ $= 12$
$(x - 4)(x + 5)$; ■ $= 20$

41. $(x + 1)(x + 12)$; ■ $= 13$
$(x + 2)(x + 6)$; ■ $= 8$
$(x + 3)(x + 4)$; ■ $= 7$

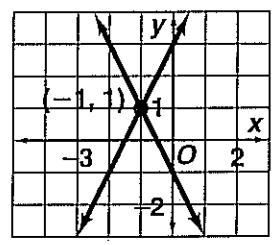
42. Let $x^2 + bx + c = (x + p)(x + q)$. **42a.** If $c > 0$, then p and q must be of the same sign. If $b > 0$, then p and q are both positive. If $b < 0$, then p and q are negative. **42b.** If $c < 0$, then p and q are of opposite sign. **43.** $8 \cdot 2 = 16; 8 + 2 = 10; k^2 + 10k + 16 = (k + 8)(k + 2)$ **44.** $-2 \cdot 12 = -24; -2 + 12 = 10; m^2 + 10m - 24 = (m - 2)(m + 12)$ **45.** $-4 \cdot 14 = -56; -4 + 14 = 10; n^2 + 10n - 56 = (n - 4)(n + 14)$ **46.** $8 \cdot 12 = 96; 8 + 12 = 20; g^2 + 20g + 96 = (g + 8)(g + 12)$ **47.** $-5 \cdot 13 = -65; -5 + 13 = 8; x^2 + 8x - 65 = (x - 5)(x + 13)$ **48.** $3 \cdot 25 = 75; 3 + 25 = 28; t^2 + 28t + 75 = (t + 3)(t + 25)$ **49.** $-14 \cdot 3 = -42; -14 + 3 = -11; x^2 - 11x - 42 = (x - 14)(x + 3)$ **50.** $2 \cdot 21 = 42; 2 + 21 = 23; k^2 + 23k + 42 = (k + 2)(k + 21)$ **51.** $-3 \cdot 17 = -51; -3 + 17 = 14; m^2 + 14m - 51 = (m - 3)(m + 17)$ **52.** $4 \cdot 25 = 100; 4 + 25 = 29; x^2 + 29xy + 100y^2 = (x + 4y)(x + 25y)$ **53.** $-15 \cdot 5 = -75; -15 + 5 = -10; t^2 - 10t - 75 = (t - 15)(t + 5)$ **54.** $-3 \cdot -16 = 48; -3 + (-16) = -19; d^2 - 19de + 48e^2 = (d - 3e)(d - 16e)$ **55.** $4x^2 + 10x + 2x + 5 = 4x^2 + (10 + 2)x + 5 = 4x^2 + 12x + 5; 4x^2 + 12x + 5 = (2x + 1)(2x + 5)$ **56.** $6x^2 + 9x + 4x + 6 = 6x^2 + (9 + 4)x + 6 = 6x^2 + 13x + 6; 6x^2 + 13x + 6 = (3x + 2)(2x + 3)$ **57a.** The signs of a and b must be opposite. **57b.** Because the middle term is negative, the number with the larger absolute value must be negative. So a must be a negative integer. **58a.** The signs of a and b must be opposite. **58b.** Because the middle term is positive, the number with the larger absolute value must be positive. So b is a negative integer. **59.** $7 \cdot 5 = 35; 7 + 5 = 12; x^{12} + 12x^6 + 35 = x^{6+6} + 12x^6 + 35 = (x^6 + 7)(x^6 + 5)$ **60.** $-3 \cdot 8 = -24; -3 + 8 = 5; t^8 + 5t^4 - 24 = t^{4+4} + 5t^4 - 24 = (t^4 - 3)(t^4 + 8)$ **61.** $-16 \cdot -5 = -80; -16 + (-5) = -21; r^6 - 21r^3 + 80 = r^{3+3} - 21r^3 + 80 = (r^3 - 16)(r^3 - 5)$ **62.** $17 \cdot 1 = 17; 17 + 1 = 18; m^{10} + 18m^5 + 17 = m^{5+5} + 18m^5 + 17 = (m^5 + 17)(m^5 + 1)$ **63.** $-24 \cdot 5 = -120; -24 + 5 = -21; x^{12} - 19x^6 - 120 = x^{6+6} - 19x^6 - 120 = (x^6 - 24)(x^6 + 5)$ **64.** $-4 \cdot 18 = -72; -4 + 18 = 14; p^6 + 14p^3 - 72 = p^{3+3} + 14p^3 - 72 = (p^3 - 4)(p^3 + 18)$ **65.** $72 \div 16 = 4.5$; the answer is B. **66.** $-36 = -4 \cdot 9; -4 + 9 = 5$; the answer is F. **67. A.** $25 = 5 \cdot 5$; sum $= 10$ **B.** $24 = 4 \cdot 6$; sum $= 10$ **C.** $21 = 3 \cdot 7$; sum $= 10$ **D.** $18 = 1 \cdot 18 = 2 \cdot 9 = 3 \cdot 6$; no sum $= 10$; the answer is D. **68.** Area $= x^2 + 11x + 18$; the answer is I. **69.** $6 \cdot 12 = 72; 6 + 12 = 18$; the answer is A. **70.** $-10 \cdot -5 = 50; -10 + (-5) = -15$; the answer is F. **71.** Terms in factors must be of opposite sign. Factor -40; $-40 = -1 \cdot 40 = 1 \cdot -40 = -2 \cdot 20 = 2 \cdot -20 = -4 \cdot 10 = 4 \cdot -10 = -5 \cdot 8 = 5 \cdot -8$; search for products whose sum $= -18$; find $2 + (-20) = -18$; factors are $(x + 2)(x - 20) = x^2 - 18 - 40$
[1] correct factors only OR explanation only
72. $(x + 4)(x + 4) = (x)^2 + 2x(4) + (4)^2 = x^2 + 8x + 16$ **73.** $(w - 6)(w - 6) = (w)^2 - 2w(6) + (6)^2 = w^2 - 12w + 36$ **74.** $(r - 5)(r + 5) = (r)^2 - (5)^2 = r^2 - 25$ **75.** $(2q + 7)(2q + 7) = (2q)^2 + 2(2q)(7) + (7)^2 = 4q^2 + 28q + 49$ **76.** $(8v - 2)(8v + 2) = (8v)^2 - (2)2 = 64v^2 - 4$ **77.** $(3a - 9)(3a - 9) = (3a)^2 - 2(3a)(9) + (9)^2 = 9a^2 - 54a + 81$ **78.** $(3a - 5)(3a + 5) = (3a)^2 - (5)^2 = 9a^2 - 25$ **79.** $(6t + 9)(6t + 9) = (6t)^2 + 2(6t)(9) + (9)^2 = 36t^2 + 108t + 81$ **80.** $(2x + 8y)(2x - 8y) = (2x)^2 - (8y)^2 = 4x^2 - 64y^2$

81.
$$\begin{aligned} 40 + 18x &= 220 - 12x \\ 40 + 30x &= 220 \\ 30x &= 180 \\ x &= 6 \end{aligned}$$
The accounts will be the same after 6 weeks.

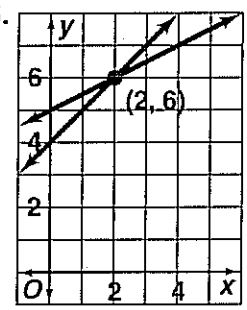
82.
$$\begin{aligned} m + n &= 42 \\ n &= 42 - m \\ 2m - 63 &= n \\ 2m - 63 &= 42 - m \\ 3m - 63 &= 42 \\ 3m &= 105 \\ m &= 35 \\ n &= 42 - 35 = 7 \end{aligned}$$

83a.
$$\begin{aligned} b + d &= 129 \\ 119.99b + 149.99d &= 16{,}918.71 \\ b &= 129 - d \\ 119.99(129 - d) + 149.99d &= 16{,}918.71 \\ 30d &= 16{,}918.71 - 15{,}478.71 \\ 30d &= 1440 \\ d &= 48 \\ b &= 129 - 48 = 81 \end{aligned}$$
81 basic players, 48 deluxe players

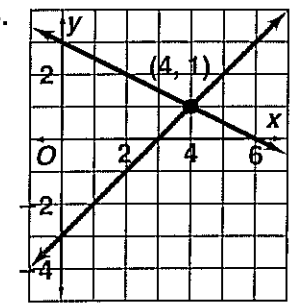
84.



85.



86.



9-6 Factoring Trinomials of the Type $ax^2 + bx + c$ pages 486–489

Check Skills You'll Need p. 486 For complete solutions see *Daily Skills Check and Lesson Quiz Transparencies* or *Presentation Pro CD-ROM.*

1. $6x$ **2.** 7 **3.** 2 **4.** $(x + 1)(x + 4)$ **5.** $(y - 7)(y + 4)$ **6.** $(t - 5)(t - 6)$

Check Understanding

1a. $2y^2 \quad + 5y \quad + 2$

F	O	I	L
$1 \cdot 2$	$1 \cdot 2 +$	$1 \cdot 2 = 4$	$1 \cdot 2$
$1 \cdot 2$	$1 \cdot 1 +$	$2 \cdot 2 = 5$ ✓	$2 \cdot 1$

$(y + 2)(2y + 1) = 2y^2 + 5y + 2$

1b. $6n^2 \quad -23n \quad + 7$

F	O	I	L
$1 \cdot 6$	$1 \cdot -7 +$	$-1 \cdot 6 = -13$	$-1 \cdot -7$
$1 \cdot 6$	$1 \cdot -1 +$	$-7 \cdot 6 = -43$	$-7 \cdot -1$
$2 \cdot 3$	$2 \cdot -7 +$	$-1 \cdot 3 = -17$	$-1 \cdot -7$
$2 \cdot 3$	$2 \cdot -1 +$	$-7 \cdot 3 = -23$ ✓	$-7 \cdot -1$

$(2n - 7)(3n - 1) = 6n^2 - 23n + 7$

1c. $2y^2 \quad - 5y \quad + 2$

F	O	I	L
$1 \cdot 2$	$1 \cdot -2 +$	$-1 \cdot 2 = -4$	$-1 \cdot -2$
$1 \cdot 2$	$1 \cdot -1 +$	$-2 \cdot 2 = -5$ ✓	$-2 \cdot -1$

$(y - 2)(2y - 1) = 2y^2 - 5y + 2$

2a. $5d^2 \quad - 14d \quad - 3$

F	O	I	L
$1 \cdot 5$	$1 \cdot -3 +$	$1 \cdot 5 = 2$	$1 \cdot -3$
$1 \cdot 5$	$1 \cdot -1 +$	$3 \cdot 5 = 14$	$3 \cdot -1$
$1 \cdot 5$	$1 \cdot 1 +$	$-3 \cdot 5 = -14$ ✓	$-3 \cdot 1$

$(d - 3)(5d + 1) = 5d^2 - 14d - 3$

2b. $2n^2 \quad + 5n \quad - 3$

F	O	I	L
$1 \cdot 2$	$1 \cdot -3 +$	$1 \cdot 2 = -1$	$1 \cdot -3$
$1 \cdot 2$	$1 \cdot 3 +$	$-1 \cdot 2 = 1$ ✓	$-1 \cdot 3$

$(n - 1)(2n + 3) = 2n^2 + n - 3$

2c. $20p^2 \quad - 31p \quad - 9$

F	O	I	L
$1 \cdot 20$	$1 \cdot -9 +$	$1 \cdot 20 = 11$	$1 \cdot -9$
$1 \cdot 20$	$1 \cdot -3 +$	$3 \cdot 20 = 57$	$3 \cdot -3$
$2 \cdot 10$	$2 \cdot -9 +$	$1 \cdot 10 = -8$	$1 \cdot -9$
$2 \cdot 10$	$2 \cdot -3 +$	$3 \cdot 10 = 24$	$3 \cdot -3$
$4 \cdot 5$	$4 \cdot -9 +$	$1 \cdot 5 = -31$ ✓	$1 \cdot -9$

$(4p + 1)(5p - 9) = 20p^2 - 31p - 9$

3a. $v^2 \quad - 6v \quad + 5$

F	O	I	L
$1 \cdot 1$	$1 \cdot -5 +$	$-1 \cdot 1 = -6$ ✓	$-1 \cdot -5$

$2(v - 1)(v - 5) = 2(v^2 - 6v + 5) = 2v^2 - 12v + 10$

3b. $2y^2 \quad + 7y \quad + 3$

F	O	I	L
$1 \cdot 2$	$1 \cdot 3 +$	$1 \cdot 2 = 5$	$1 \cdot 3$
$1 \cdot 2$	$1 \cdot 1 +$	$3 \cdot 2 = 7$ ✓	$3 \cdot 1$

$2(y + 3)(2y + 1) = 2(2y^2 + 7y + 3) = 4y^2 + 14y + 6$

3c. $3k^2 \quad - 2k \quad - 1$

F	O	I	L
$1 \cdot 3$	$1 \cdot -1 +$	$1 \cdot 3 = 2$	$1 \cdot -1$
$1 \cdot 3$	$1 \cdot 1 +$	$-1 \cdot 3 = -2$ ✓	$-1 \cdot 1$

$6(k - 1)(3k + 1) = 6(3k^2 - 2k - 1) = 18k^2 - 12k - 6$

Exercises

1. $2n^2 \quad + 15n \quad + 7$

F	O	I	L
$1 \cdot 2$	$1 \cdot 7 +$	$1 \cdot 2 = 9$	$1 \cdot 7$
$1 \cdot 2$	$1 \cdot 1 +$	$7 \cdot 2 = 15$ ✓	$7 \cdot 1$

$(n + 7)(2n + 1) = 2n^2 + 15n + 7$

2. $7d^2 \quad 50d \quad + 7$

F	O	I	L
$1 \cdot 7$	$1 \cdot 1 +$	$7 \cdot 7 = 50$ ✓	$7 \cdot 1$

$(d + 7)(7d + 1) = 7d^2 + 50d + 7$

3. $11w^2 \quad - 14w \quad + 3$

F	O	I	L
$1 \cdot 11$	$1 \cdot -3 +$	$-1 \cdot 11 = -14$ ✓	$-1 \cdot -3$

$(w - 1)(11w - 3) = 11w^2 - 14w + 3$

4. $3x^2 \quad - 17x \quad + 10$

F	O	I	L
$1 \cdot 3$	$1 \cdot -10 +$	$-1 \cdot 3 = -13$	$-1 \cdot -10$
$1 \cdot 3$	$1 \cdot -2 +$	$-5 \cdot 3 = -17$ ✓	$-5 \cdot -2$

$(x - 5)(3x - 2) = 3x^2 - 17x + 10$

5. $6t^2 \quad + 25t \quad + 11$

F	O	I	L
$1 \cdot 6$	$1 \cdot 1 +$	$11 \cdot 6 = 67$	$11 \cdot 1$
$2 \cdot 3$	$2 \cdot 11 +$	$1 \cdot 3 = 25$ ✓	$1 \cdot 11$

$(2t + 1)(3t + 11) = 6t^2 + 25t + 11$

6. $3d^2 \quad - 17d \quad + 20$

F	O	I	L
$1 \cdot 3$	$1 \cdot -20 +$	$-1 \cdot 3 = -23$	$-1 \cdot -20$
$1 \cdot 3$	$1 \cdot -5 +$	$-4 \cdot 3 = -17$ ✓	$-4 \cdot -5$

$(d - 4)(3d - 5) = 3d^2 - 17d + 20$

7. $16m^2 \quad + 26m \quad + 9$

F	O	I	L
$2 \cdot 8$	$2 \cdot 9 +$	$1 \cdot 8 = 26$ ✓	$1 \cdot 9$

$(2m + 1)(8m + 9) = 16m^2 + 26m + 9$

8. $15p^2 \quad - 26p \quad + 11$

F	O	I	L
$1 \cdot 15$	$1 \cdot -11 +$	$-1 \cdot 15 = -26$ ✓	$-1 \cdot -11$

$(p - 1)(15p - 11) = 15p^2 - 26p + 11$

9. $8y^2 \quad + 30y \quad + 13$

F	O	I	L
$1 \cdot 8$	$1 \cdot 13 +$	$1 \cdot 8 = 21$	$1 \cdot 13$
$1 \cdot 8$	$1 \cdot 1 +$	$13 \cdot 8 = 105$	$13 \cdot 1$
$2 \cdot 4$	$2 \cdot 13 +$	$1 \cdot 4 = 30$ ✓	$1 \cdot 13$

$(2y + 1)(4y + 13) = 8y^2 + 30y + 13$

10. $2y^2 \quad + 35y \quad + 17$

F	O ·	I	L
$1 \cdot 2$	$1 \cdot 17 +$	$1 \cdot 2 = 19$	$1 \cdot 17$
$1 \cdot 2$	$1 \cdot 1 +$	$17 \cdot 2 = 35$ ✓	$17 \cdot 1$

$(y + 17)(2y + 1) = 2y^2 + 35y + 17$

11. $7x^2 \quad - 30x \quad + 27$

F	O ·	I	L
$1 \cdot 7$	$1 \cdot -27 +$	$-1 \cdot 7 = -34$	$-1 \cdot -27$
$1 \cdot 7$	$1 \cdot -1 +$	$-27 \cdot 7 = -190$	$-27 \cdot -1$
$1 \cdot 7$	$1 \cdot -9 +$	$-3 \cdot 7 = -30$ ✓	$-3 \cdot -9$

$(x - 3)(7x - 9) = 7x^2 - 30x - 27$

12. $8x^2 \quad + 18x \quad + 9$

F	O ·	I	L
$1 \cdot 8$	$1 \cdot 9 +$	$1 \cdot 8 = 17$	$1 \cdot 9$
$1 \cdot 8$	$1 \cdot 3 +$	$3 \cdot 8 = 27$	$3 \cdot 3$
$2 \cdot 4$	$2 \cdot 9 +$	$1 \cdot 4 = 22$	$1 \cdot 9$
$2 \cdot 4$	$2 \cdot 3 +$	$3 \cdot 4 = 18$ ✓	$3 \cdot 3$

$(2x + 3)(4x + 3) = 8x^2 + 18x + 9$

13. $2t^2 \quad - t \quad - 3$

F	O ·	I	L
$1 \cdot 2$	$1 \cdot -3 +$	$1 \cdot 2 = -1$ ✓	$1 \cdot -3$

$(t + 1)(2t - 3) = 2t^2 - t - 3$

14. $8y^2 \quad - 10y \quad - 3$

$1 \cdot 8$	$1 \cdot -3 +$	$1 \cdot 8 = 5$	$1 \cdot -3$
$1 \cdot 8$	$1 \cdot -1 +$	$3 \cdot 8 = 23$	$3 \cdot -1$
$2 \cdot 4$	$2 \cdot -1 +$	$1 \cdot 4 = 2$	$1 \cdot -3$
$2 \cdot 4$	$2 \cdot -1 +$	$3 \cdot 4 = 10$	$3 \cdot -1$
$2 \cdot 4$	$2 \cdot 1 +$	$-3 \cdot 4 = -10$ ✓	$-3 \cdot 1$

$(2y - 3)(4y + 1) = 8y^2 - 10y - 3$

15. $2q^2 \quad - 11q \quad - 21$

$1 \cdot 2$	$1 \cdot -21 +$	$1 \cdot 2 = -19$	$1 \cdot -21$
$1 \cdot 2$	$1 \cdot -7 +$	$3 \cdot 2 = -1$	$3 \cdot -7$
$2 \cdot 1$	$2 \cdot -7 +$	$3 \cdot 1 = -11$ ✓	$3 \cdot -7$

$(2q + 3)(q - 7) = 2q^2 - 11q - 21$

16. $7x^2 \quad - 20x \quad - 3$

$1 \cdot 7$	$1 \cdot -1 +$	$3 \cdot 7 = 20$	$3 \cdot -1$
$1 \cdot 7$	$1 \cdot 1 +$	$-3 \cdot 7 = -20$ ✓	$-3 \cdot 1$

$(x - 3)(7x + 1) = 7x^2 - 20x - 3$

17. $13p^2 \quad + 8p \quad - 5$

$1 \cdot 13$	$1 \cdot -5 +$	$1 \cdot 13 = 8$ ✓	$1 \cdot -5$

$(p + 1)(13p - 5) = 13p^2 + 8p - 5$

18. $5k^2 \quad - 2k \quad - 7$

$1 \cdot 5$	$1 \cdot -7 +$	$1 \cdot 5 = -2$ ✓	$1 \cdot -7$

$(k + 1)(5k - 7) = 5k^2 - 2k - 7$

19. $10w^2 \quad + 11w \quad - 8$

$1 \cdot 10$	$1 \cdot -8 +$	$1 \cdot 10 = 2$	$1 \cdot -8$
$1 \cdot 10$	$1 \cdot -4 +$	$2 \cdot 10 = 16$	$2 \cdot -4$
$1 \cdot 10$	$1 \cdot -2 +$	$4 \cdot 10 = 38$	$4 \cdot -2$
$2 \cdot 5$	$2 \cdot -8 +$	$1 \cdot 5 = -11$	$1 \cdot -8$
$2 \cdot 5$	$2 \cdot 8 +$	$-1 \cdot 5 = 11$ ✓	$-1 \cdot 8$

$(2w - 1)(5w + 8) = 10w^2 + 11w - 8$

20. $12d^2 \quad - d \quad - 20$

$2 \cdot 6$	$2 \cdot -10 +$	$2 \cdot 6 = -8$	$2 \cdot -10$
$2 \cdot 6$	$2 \cdot -5 +$	$4 \cdot 6 = 14$	$4 \cdot -5$
$3 \cdot 4$	$3 \cdot -5 +$	$4 \cdot 4 = 1$	$4 \cdot -5$
$3 \cdot 4$	$3 \cdot 5 +$	$-4 \cdot 4 = -1$ ✓	$-4 \cdot 5$

$(3d - 4)(4d + 5) = 12d^2 - d - 20$

21. $14n^2 \quad + 23n \quad - 15$

$2 \cdot 7$	$2 \cdot -15 +$	$1 \cdot 7 = -23$	$1 \cdot -15$
$2 \cdot 7$	$2 \cdot 15 +$	$-1 \cdot 7 = 23$ ✓	$-1 \cdot 15$

$(2n - 1)(7n + 15) = 14n^2 + 23n - 15$

22. $3m^2 \quad - 4m \quad + 1$

F	O ·	I	L
$1 \cdot 3$	$1 \cdot -1 +$	$-1 \cdot 3 = -4$ ✓	$-1 \cdot -1$

$8(m - 1)(3m - 1) = 8(3m^2 - 4m + 1) =$
$24m^2 - 32m + 8$

23. $3v^2 \quad - 10v \quad + 7$

$1 \cdot 3$	$1 \cdot -7 +$	$-1 \cdot 3 = -10$ ✓	-7

$7(v - 1)(3v - 7) = 7(3v^2 - 10v + 7) = 21v^2 - 70v + 49$

24. $3t^2 \quad + 13t \quad + 12$

$1 \cdot 3$	$1 \cdot 4 +$	$3 \cdot 3 = 13$ ✓	$3 \cdot 4$

$2(t + 3)(3t + 4) = 2(3t^2 + 13t + 12) = 6t^2 + 26t + 24$

25. $5x^2 \quad - 2x \quad - 3$

$1 \cdot 5$	$1 \cdot -3 +$	$1 \cdot 5 = 2$	$1 \cdot -3$
$1 \cdot 5$	$1 \cdot 3 +$	$-1 \cdot 5 = -2$ ✓	$-1 \cdot 3$

$5(x - 1)(5x + 3) = 5(5x^2 - 2x - 3) = 25x^2 - 10x - 15$

26. $p^2 \quad + 7p \quad + 6$

$1 \cdot 1$	$1 \cdot 6 +$	$1 \cdot 1 = 7$ ✓	$1 \cdot 6$

$11(p + 1)(p + 6) = 11(p^2 + 7p + 6) = 11p^2 + 77p + 66$

27. $12v^2 \quad + 5v \quad - 3$

$3 \cdot 4$	$3 \cdot -3 +$	$1 \cdot 4 = -5$	$1 \cdot -3$
$3 \cdot 4$	$3 \cdot 3 +$	$-1 \cdot 4 = 5$ ✓	$-1 \cdot 3$

$2(3v - 1)(4v + 3) = 2(12v^2 + 5v - 3) =$
$24v^2 + 10v - 6$

28. Samples:

	x
$4g^2 + xg + 10 = (g + 1)(4g + 10)$	14
$= (g + 2)(4g + 5)$	13
$= (g + 5)(4g + 2)$	22
$= (g + 10)(4g + 1)$	41
$= (2g + 1)(2g + 10)$	22
$= (2g + 2)(2g + 5)$	14

29. Samples:

$15m^2 + xm - 24 = (m + 1)(15m - 24)$	-9
$= (m - 1)(15m + 24)$	9
$= (m - 24)(15m + 1)$	-359
$= (3m - 1)(5m + 24)$	67
$= (3m - 24)(5m + 1)$	-117
$= (3m + 24)(5m - 1)$	117

30. Samples:

$35g^2 + xg - 16 = (g + 1)(35g - 16)$ 19
$= (g - 16)(35g + 1)$ −559
$= (5g - 1)(7g + 16)$ 73
$= (5g + 16)(7g - 1)$ 107

31a. $(2x + 2)(x + 2)$; $(x + 1)(2x + 4)$

31b. $(2x + 2)(x + 2) = 2x^2 + 6x + 4$; $(x + 1)(2x + 4) = 2x^2 + 6x + 4$; yes **31c.** $(2x + 2)(x + 2) = 2(x + 1)(x + 2)$; $(x + 1)(2x + 4) = 2(x + 1)(2x + 2)$; upon complete factoring the two expressions are the same.

32. First factor out the GCF = 2; $50x^2 - 90x + 16 = 2(25x^2 - 45x + 8)$. Next factor $25 = 1 \cdot 25 = 5 \cdot 5$ and $8 = 1 \cdot 8 = 2 \cdot 4 = 4 \cdot 2 = 8 \cdot 1$; there are 6 possibilities. $25x^2 - 45x + 8 = (px + q)(rx + s)$; p, r both positive. q and s are both negative in this case.

$25x^2$ $- 45x$ $+ 8$
$1 \cdot 25$ $1 \cdot -8 +$ $-1 \cdot 25 = -33$ $-1 \cdot -8$
$5 \cdot 5$ $5 \cdot -8 +$ $-1 \cdot 5 = -45$ ✓ $-1 \cdot -8$

Check: $2(5x - 1)(5x - 8) = 2(25x^2 - 45x + 8) = 50x^2 - 90x + 16$.

33. $54p^2$ $+ 87p$ $+ 28$
$1 \cdot 54$ $1 \cdot 28 +$ $1 \cdot 54 = 82$ $1 \cdot 28$
$1 \cdot 54$ $1 \cdot 7 +$ $4 \cdot 54 = 223$ $4 \cdot 7$
$2 \cdot 27$ $2 \cdot 28 +$ $1 \cdot 27 = 83$ $1 \cdot 28$
$2 \cdot 27$ $2 \cdot 14 +$ $2 \cdot 27 = 82$ $2 \cdot 14$
$3 \cdot 18$ $3 \cdot 28 +$ $1 \cdot 18 = 102$ $1 \cdot 28$
$3 \cdot 18$ $3 \cdot 7 +$ $4 \cdot 18 = 93$ $4 \cdot 7$
$6 \cdot 9$ $6 \cdot 7 +$ $4 \cdot 9 = 78$ $4 \cdot 7$
$6 \cdot 9$ $6 \cdot 4 +$ $7 \cdot 9 = 87$ ✓ $7 \cdot 4$

$(6p + 7)(9p + 4) = 54p^2 + 87p + 28$

34. $22r^2$ $+ 19r$ $+ 4$
$2 \cdot 11$ $2 \cdot 4 +$ $1 \cdot 11 = 19$ ✓ $1 \cdot 4$

$3(2r + 1)(11r + 4) = 3(22r^2 + 19r + 4) = 66r^2 + 57r + 12$

35. $14x^2$ $- 53x$ $+ 14$
$1 \cdot 14$ $1 \cdot -14 +$ $-1 \cdot 14 = -28$ $-1 \cdot -14$
$2 \cdot 7$ $2 \cdot -7 +$ $-2 \cdot 7 = -28$ $-2 \cdot -7$
$2 \cdot 7$ $2 \cdot -2 +$ $-7 \cdot 7 = -53$ ✓ $-7 \cdot -2$

$(2x - 7)(7x - 2) = 14x^2 - 53x + 14$

36. $28m^2 + 28m - 56 = 28(m^2 + m - 2) = 28(m + 2)(m - 1)$

37. $7h^2$ $+ 24h$ $- 16$
$1 \cdot 7$ $1 \cdot -8 +$ $2 \cdot 7 = 6$ $2 \cdot -8$
$1 \cdot 7$ $1 \cdot -4 +$ $4 \cdot 7 = 24$ ✓ $4 \cdot -4$

$3(h + 4)(7h - 4) = 3(7h^2 + 24h - 16) = 21h^2 + 72h - 48$

38. $55n^2$ $- 52n$ $+ 12$
$5 \cdot 11$ $5 \cdot -12 +$ $-1 \cdot 11 = -71$ $-1 \cdot -12$
$5 \cdot 11$ $5 \cdot -6 +$ $-2 \cdot 11 = -52$ ✓ $-2 \cdot -6$

$(5n - 2)(11n - 6) = 55n^2 - 52n - 12$

39. $18y^2$ $+ 57y$ $- 10$
$2 \cdot 9$ $2 \cdot -10 +$ $1 \cdot 9 = -11$ $1 \cdot -10$
$3 \cdot 6$ $3 \cdot -10 +$ $1 \cdot 6 = -24$ $1 \cdot -10$
$3 \cdot 6$ $3 \cdot -1 +$ $10 \cdot 6 = 57$ ✓ $10 \cdot -1$

$2(3y + 10)(6y - 1) = 2(18y^2 + 57y - 10) = 36y^2 + 114y - 20$

40. $63w^2$ $- 89w$ $+ 30$
$7 \cdot 9$ $7 \cdot -10 +$ $-3 \cdot 9 = -97$ $-3 \cdot -10$
$7 \cdot 9$ $7 \cdot -6 +$ $-5 \cdot 9 = -87$ $-5 \cdot -6$
$7 \cdot 9$ $7 \cdot -5 +$ $-6 \cdot 9 = -89$ ✓ $-6 \cdot -5$

$(7w - 6)(9w - 5) = 63w^2 - 89w + 30$

41. $99q^2$ $- 92q$ $+ 9$
$1 \cdot 99$ $1 \cdot -9 +$ $-1 \cdot 99 = -108$ $-1 \cdot -9$
$1 \cdot 99$ $1 \cdot -1 +$ $-9 \cdot 99 = -890$ $-9 \cdot -1$
$1 \cdot 99$ $1 \cdot -3 +$ $-3 \cdot 99 = -300$ $-3 \cdot -3$
$3 \cdot 33$ $3 \cdot -9 +$ $-1 \cdot 33 = -60$ $-1 \cdot -9$
$3 \cdot 33$ $3 \cdot -3 +$ $-3 \cdot 33 = -108$ $-3 \cdot -3$
$9 \cdot 11$ $9 \cdot -9 +$ $-1 \cdot 11 = -920$ ✓ $-1 \cdot -9$

$(9q - 1)(11q - 9) = 99q^2 - 92q + 9$

42. a and c cannot be factored; $ax^2 + bx + c$ can be factored as $(ax + 1)(x + c)$ or $(ax + c)(x + 1)$; $b = ac + 1$ or $b = a + c$; there are two choices for b.

43. $ax^2 - 12x + c = (px + q)(rx + s)$; choose p, r positive; $ps + qr = -12$; q, s are negative in this case. Samples:

p	s	q	r	$ps + qr$	$a = pr$	$c = qs$
1	−1	−1	11	−12	11	1
1	−1	−11	1	−12	1	11
2	−1	−1	10	−12	20	1
2	−1	−10	1	−12	2	10
2	−1	−2	5	−12	10	2
2	−1	−5	2	−12	4	5
3	−1	−1	9	−12	27	1

44. $56x^2$ $+ 43x$ $+ 5$
$7 \cdot 8$ $7 \cdot 5 +$ $1 \cdot 8 = 43$ ✓ $1 \cdot 5$

Mental math showed that $1 \cdot 56$ or $2 \cdot 28$ would not be helpful. $x(7x + 1)(8x + 5) = x(56x^2 + 43x + 5) = 56x^3 + 43x^2 + 5x$

45. $49p^2$ $+ 63pq$ $- 36q^2$
$7 \cdot 7$ $7 \cdot -12 +$ $3 \cdot 7 = -63$ $3 \cdot -12$
$7 \cdot 7$ $7 \cdot 12 +$ $-3 \cdot 7 = 63$ ✓ $-3 \cdot 12$

$(7p - 3q)(7p + 12q) = 49p^2 + 63pq - 36q^2$

46. $108g^2h - 162gh + 54h = 54h(2g^2 - 3g + 1) = 54h(2g - 1)(g - 1)$ ✓ **47a.** −2 and −3

47b. $x^2 + 5x + 6 = (x + 2)(x + 3)$ **47c.** When $y = (x + 2)(x + 3) = 0$, then $(x + 2) = 0$ so $x = -2$; or $(x + 3) = 0$ so $x = -3$.

48. $12n^2 + 32n - 140 = 4(3n^2 + 8n - 30) = 4(n + 5)(3n - 7)$; the answer is D.

49. $8p^2 + xp + 11 = (p + 1)(8p + 11)$; $x = 19$
$= (p + 11)(8p + 1)$; $x = 89$
$= (2p + 1)(4p + 11)$; $x = 26$
$= (2p + 11)(4p + 1)$; $x = 46$

The answer is G.

50. $13x^2$ $+ 32x$ $- 21$
$1 \cdot 13$ $1 \cdot -7 +$ $3 \cdot 13 = 32$ ✓ $3 \cdot -7$

$(x + 3)(13x - 7)$; the answer is D.

51. $3x^2 \quad + 22x \quad + 24$

$1 \cdot 3$	$1 \cdot 12 +$	$2 \cdot 3 = 18$	$2 \cdot 12$
$1 \cdot 3$	$1 \cdot 8 +$	$3 \cdot 3 = 17$	$3 \cdot 8$
$1 \cdot 3$	$1 \cdot 6 +$	$4 \cdot 3 = 18$	$4 \cdot 6$
$1 \cdot 3$	$1 \cdot 4 +$	$6 \cdot 3 = 22$ ✓	$6 \cdot 4$

Sides of rectangle are $(x + 6)$ and $(3x + 4)$. Perimeter is $2(x + 6) + 2(3x + 4) = 8x + 20$. The answer is H.

52. The median is the middle value; the answer is D.

53. [2] $3x^2 \quad + 40x \quad - 75$

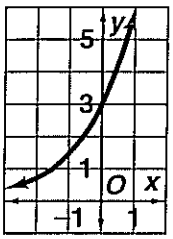
$1 \cdot 3$	$1 \cdot -15 +$	$5 \cdot 3 = 0$	$5 \cdot -15$
$1 \cdot 3$	$1 \cdot -5 +$	$15 \cdot 3 = 40$ ✓	$15 \cdot -5$

$3x^2 + 40x - 75 = (x + 15)(3x - 5)$

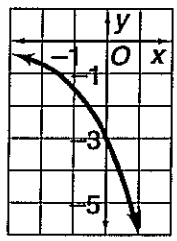
[1] minor error OR no work shown

54. $1 \cdot 7 = 7; 1 + 7 = 8; y^2 + 8y + 7 = (y + 1)(y + 7)$ **55.** $-4 \cdot -3 = 12; -4 + (-3) = -7; t^2 - 7t + 12 = (t - 4)(t - 3)$ **56.** $-5 \cdot 4 = -20; -5 + 4 = -1; t^2 - 7t + 12 = (t - 5)(t + 4)$ **57.** $-12 \cdot -3 = 36; -12 + (-3) = -15; m^2 - 15m + 36 = (m - 12)(m - 3)$ **58.** $-2 \cdot 18 = -36; -2 + 18 = 16; k^2 + 16k - 36 = (k - 2)(k + 18)$ **59.** $9 \cdot 8 = 72; 9 + 8 = 17; g^2 + 17g + 72 = (g + 9)(g + 8)$ **60.** $-16 \cdot 3 = -48; -16 + 3 = -13; h^2 - 13h - 48 = (h - 16)(h + 3)$ **61.** $-15 \cdot 2 = -30; -15 + 2 = -13; x^2 - 13x - 30 = (x - 15)(x + 2)$ **62.** $-14 \cdot -4 = 56; -14 + (-4) = -18; d^2 - 18d + 56 = (d - 14)(d - 4)$ **63.** $89^2 = (90 - 1)^2 = 8100 - 180 + 1 = 7921$ **64.** $401^2 = (400 + 1)^2 = 160{,}000 + 800 + 1 = 160{,}801$ **65.** $903^3 = (900 + 3)^2 = 810{,}000 + 5400 + 9 = 815{,}409$ **66.** $197^2 = (200 - 3)^2 = 40{,}000 - 1200 + 9 = 38{,}809$ **67.** $39 \cdot 41 = (40 - 1)(40 + 1) = 1600 - 1 = 1599$ **68.** $38 \cdot 42 = (40 - 2)(40 + 2) = 1600 - 4 = 1596$ **69.** $198 \cdot 202 = (200 - 2)(200 + 2) = 40{,}000 - 4 = 39{,}996$ **70.** $73 \cdot 67 = (70 + 3)(70 - 3) = 4900 - 9 = 4891$ **71.** $f(-3) = 4 \cdot 2^{-3} = 4 \cdot \frac{1}{2^3} = \frac{1}{2}; 4 \cdot 2^0 = 4; 4 \cdot 2^2 = 4 \cdot 4 = 16$ **72.** $h(-3) = -3 \cdot 3^{-3} = \frac{-3}{3^3} = -\frac{1}{9}; -3 \cdot 3^0 = -3; -3 \cdot 3^2 = -27$ **73.** $k(-3) = \frac{1}{3} \cdot 3^{-3} = \frac{1}{3^4} = \frac{1}{81}; \frac{1}{3} \cdot 3^0 = \frac{1}{3}; \frac{1}{3} \cdot 3^2 = 3$ **74.** $g(-3) = 5 \cdot \left(\frac{1}{10}\right)^{-3} = 5 \cdot 10^3 = 5000; 5 \cdot \left(\frac{1}{10}\right)^0 = 5; 5 \cdot \left(\frac{1}{10}\right)^2 = \frac{5}{100} = \frac{1}{20}$ **75.** $g(-3) = \frac{1}{10} \cdot 5^{-3} = \frac{1}{10} \cdot \frac{1}{5^3} = \frac{1}{1250}; \frac{1}{10} \cdot 5^0 = \frac{1}{10}; \frac{1}{10} \cdot 5^2 = \frac{25}{10} = \frac{5}{2} = 2\frac{1}{2}$ **76.** $h(-3) = 8 \cdot (0.2)^{-3} = 8 \cdot (5)^3 = 1000; 8 \cdot (0.2)^0 = 8; 8 \cdot (0.2)^2 = 8 \cdot 0.04 = 0.32$

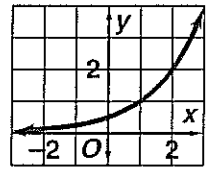
77.



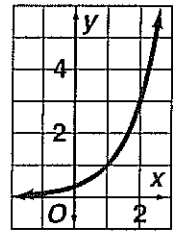
78.



79.



80.



9-7 Factoring Special Cases pages 490–495

Check Skills You'll Need p. 490 For complete solutions see *Daily Skills Check and Lesson Quiz Transparencies* or *Presentation Pro CD-ROM.*

1. $9x^2$ **2.** $25y^2$ **3.** $225h^4$ **4.** $4a^2b^4$ **5.** $c^2 - 36$ **6.** $p^2 - 22p + 121$ **7.** $16d^2 + 56d + 49$

Investigation 1. $x^2 + 6x + 9 = (x + 3)(x + 3); x^2 + 10x + 9 = (x + 9)(x + 1); m^2 + 15m + 36 = (m + 3)(m + 12); m^2 + 12m + 36 = (m + 6)(m + 6); k^2 + 26k + 25 = (k + 1)(k + 25); k^2 + 10k + 25 = (k + 5)(k + 5)$ **2a.** $x^2 + 6x + 9; m^2 + 12m + 36; k^2 + 10k + 25$ **2b.** The last term equals the square of one half the coefficient of the middle term.

Check Understanding 1a. $x^2 + 8x + 16 = x^2 + (2 \cdot 4)x + 4 \cdot 4 = (x + 4)(x + 4) = (x + 4)^2$ **1b.** $n^2 + 16n + 64 = n^2 + 2 \cdot 8n + 8 \cdot 8 = (n + 8)^2$ **1c.** $n^2 - 16n + 64 = n^2 - 2(n \cdot 8) + 8 \cdot 8 = (n - 8)^2$ **2a.** $9g^2 - 12g + 4 = (3g)^2 - 2 \cdot 3 \cdot 2g + 2 \cdot 2 = (3g - 2)^2$ **2b.** $4t^2 + 36t + 81 = (2t)^2 + 2(2t)(9) + 9^2 = (2t + 9)^2$ **2c.** $4t^2 - 36t + 81(2t)^2 - 2(2t)(9) + 9^2 = (2t - 9)^2$ **3a.** $x^2 - 36 = x^2 - 6^2 = (x + 6)(x - 6) = x^2 - 6x + 6x - 36 = x^2 - 36$ ✓ **3b.** $m^2 - 100 = m^2 - 10^2 = (m + 10)(m - 10) = m^2 - 10m + 10m - 100 = m^2 - 100$ ✓ **3c.** $p^2 - 49 = p^2 - 7^2 = (p + 7)(p - 7) = p^2 - 7p + 7p - 49 = p^2 - 49$ ✓ **4a.** $9v^2 - 4 = (3v)^2 - 2^2 = (3v + 2)(3v - 2)$

4b. $25x^2 - 64 = (5x)^2 - 8^2 = (5x + 8)(5x - 8)$

4c. $4w^2 - 49 = (2w)^2 - 7^2 = (2w + 7)(2w - 7)$

5a. $8y^2 - 50 = 2(4y^2 - 25) = 2(2y + 5)(2y - 5)$

5b. $3c^2 - 75 = 3(c^2 - 25) = 3(c + 5)(c - 5)$

5c. $28k^2 - 7 = 7(4k^2 - 1) = 7(2k + 1)(k - 1)$

Exercises 1. $c^2 + 10c + 25 = c^2 + (2 \cdot 5)c + 5^2 = (c + 5)^2$ **2.** $x^2 - 2x + 1 = x^2 - 2(x)1 + 1^2 = (x - 1)(x - 1)$ **3.** $h^2 + 12h + 36 = h^2 + 2(h)6 + 6^2 = (h + 6)(h + 6)$ **4.** $m^2 - 24m + 144 = m^2 - 2(m)12 + 12^2 = (m - 12)(m - 12)$ **5.** $k^2 - 16k + 64 = k^2 - 2(k)8 + 8^2 = (k - 8)(k - 8)$ **6.** $t^2 - 14t + 49 = t^2 - 2(t)7 + 7^2 = t^2 - 14t + 49$ **7.** $4m^2 + 20m + 25 = (2m)^2 + 2(2 \cdot 5)m + 5^2 = (2m + 5)^2$ **8.** $49d^2 + 28d + 4 = (7d)^2 + 2(7d)2 + 2^2 = (7d + 2)(7d + 2)$ **9.** $25g^2 - 40g + 16 = (5g)^2 - 2(5g) + 4^2 = (5g - 4)(5g - 4)$ **10.** $25g^2 - 30g + 9 = (5g - 3)^2 = 25g^2 - 2(5g)(3) + 9 = 25g^2 - 30g + 9$ ✓ **11.** $64r^2 - 144r + 81 = (8r - 9)^2 = 64r^2 - 2(8r)(9) + 81 = 64r^2 - 144r + 81$ ✓ **12.** $100v^2 - 220v + 121 = (10v)^2 - 2(10v)(11) + 11^2 =$

$(10v - 11)^2 = 100v^2 - 2(110v) + 121 =$
$100v^2 - 220v + 121$ ✓ **13.** $x^2 - 4 = (x + 2)(x - 2) =$
$x^2 - 2x + 2x - 4 = x^2 - 4$ ✓ **14.** $y^2 - 81 =$
$(y + 9)(y - 9) = y^2 - 9y + 9y - 81 = y^2 - 81$ ✓
15. $k^2 - 196 = (k + 14)(k - 14) =$
$k^2 - 14k + 14k - 196 = k^2 - 196$ ✓ **16.** $r^2 - 144 =$
$(r + 12)(r - 12) = r^2 - 12r + 12r - 144 = r^2 - 144$ ✓
17. $h^2 - 100 = (h + 10)(h - 10) =$
$h^2 - 10h + 10h - 100 = h^2 - 100$ ✓ **18.** $m^2 - 225 =$
$(m + 15)(m - 15) = m^2 - 15m + 15m - 225 =$
$m^2 - 225$ **19.** $w^2 - 256 = (w + 16)(w - 16) =$
$w^2 - 16w + 16w - 256 = w^2 - 256$ ✓ **20.** $x^2 - 400 =$
$(x + 20)(x - 20) = x^2 - 20x + 20x - 400 =$
$x^2 - 400$ ✓ **21.** $y^2 - 900 = (y + 30)(y - 30) =$
$y^2 - 30y + 30y - 900 = y^2 - 900$ **22.** $25q^2 - 9 =$
$(5q)^2 - 3^2 = (5q + 3)(5q - 3) =$
$25q^2 - 15q + 15q - 9 = 25q^2 - 9$ **23.** $49y^2 - 4 =$
$(7y)^2 - 2^2 = (7y + 2)(7y - 2) = 49y^2 - 14y + 14y - 4 =$
$49y^2 - 4$ ✓ **24.** $9c^2 - 64 = (3c)^2 - 8^2 =$
$(3c + 8)(3c - 8) = 9c^2 - 24c + 24c - 64 = 9c^2 - 64$ ✓
25. $4m^2 - 81 = (2m)^2 - 9^2 = (2m + 9)(2m - 9) =$
$4m^2 - 18m + 18m - 81 = 4m^2 - 81$ ✓ **26.** $16k^2 - 49 =$
$(4k)^2 - 7^2 = (4k + 7)(4k - 7) =$
$16k^2 - 28k + 28k - 49 = 16k^2 - 49$ ✓ **27.** $144p^2 - 1 =$
$(12p)^2 - 1^2 = (12p + 1)(12p - 1) =$
$144p^2 - 12p + 12p - 1 = 144p^2 - 1$ ✓ **28.** $81v^2 - 100 =$
$(9v + 10)(9v - 10) = 81v^2 - 90v + 90v - 100 =$
$81v^2 - 100$ **29.** $400n^2 - 121 = (20n + 11)(20n - 11) =$
$400n^2 - 220n + 220n - 121 = 400n^2 - 121$ ✓
30. $25w^2 - 196 = (5w + 14)(5w - 14) =$
$25w^2 - 70w + 70w - 196 = 25w - 196$ ✓
31. $3m^2 - 12 = 3(m^2 - 4) = 3(m + 2)(m - 2) =$
$3(m^2 - 2m + 2m - 4) = 3m^2 - 12$ ✓ **32.** $5k^2 - 245 =$
$5(k^2 - 49) = 5(k + 7)(k - 7) = 5(k^2 - 7k + 7k - 49) =$
$5k^2 - 245$ ✓ **33.** $3x^2 + 48x + 192 = 3(x^2 + 16x + 64) =$
$3(x + 8)^2 = 3(x^2 + 2(8x) + 8^2) = 3(x^2 + 16x + 64) =$
$3x^2 + 48x + 192$ ✓ **34.** $2t^2 - 36t + 162 =$
$2(t^2 - 18t + 81) = 2(t - 9)^2 = 2(t^2 - 2(9t) + 81) =$
$2t^2 - 36t + 192$ ✓ **35.** $6r^3 - 150r = 6r(r^2 - 25) =$
$6r(r + 5)(r - 5) = 6r(r^2 - 5r + 5r - 25) = 6r^3 - 150r$ ✓
36. $7h^2 - 56h + 112 = 7(h^2 - 8h + 16) = 7(h - 4)^2 =$
$7(h^2 - 2(4h) + 16) = 7h^2 - 56h + 112$ ✓ **37.** Answers may vary. Sample: Rewrite the first and last terms as squares $(ax)^2$ and $(bx)^2$. Check if the middle term can be written as $2ab$. Factor as a square binomial.
$4x^2 + 12x + 9 = (2x)^2 + 2(2 \cdot 3x) + 3^2 = (2x + 3)^2$;
$9x^2 - 30x + 25 = (3x)^2 - 2(3 \cdot 5)x + 5^2 = (3x - 5)^2$.
38. two errors: sign and multiplication; $4x^2 - 121 =$
$(2x + 11)(2x - 11)$; $(4x - 11)(4x - 11) = 16x^2 - 88 + 121$
39. $99 = 100 - 1 = 10^2 - 1^2 = (10 + 1)(10 - 1) =$
$11 \cdot 9$ **40.** $91 = 100 - 9 = 10^2 - 3^2 = (10 + 3)(10 - 3) =$
$13 \cdot 7$ **41.** $75 = 100 - 25 = 10^2 - 5^2 = (10 + 5)(10 - 5) =$
$15 \cdot 5$ **42.** $117 = 121 - 4 = 11^2 - 2^2 =$
$(11 + 2)(11 - 2) = 13 \cdot 9$ **43.** $224 = 225 - 1 =$
$15^2 - 1^2 = (15 + 1)(15 - 1) = 16 \cdot 14$ **44a.** Answers may vary. Sample: $4x^2 + 24x + 36$ **44b.** because $4x^2 =$
$(2x)^2$ and $36 = 6^2$; $2 \cdot 2 \cdot 6 = 24$ **45.** $100v^2 - 25w^2 =$
$25(4v^2 - w^2) = 25[(2v)^2 - w^2] = 25(2v - w)(2v + w)$
46. $16p^2 - 48pq + 36q^2 = 4(4p^2 - 12pq + 9q^2) =$
$4[(2p)^2 - (3q)^2] = 4(2p - 3q)(2p + 3q)$
47. $28c^2 + 140cd + 175d^2 = 7(4c^2 + 20cd + 25d^2) =$
$7[(2c)^2 + (5d)^2] = 7(2c + 5d)^2$
48. $\frac{1}{4}m^2 - \frac{1}{9} = \left(\frac{1}{2}m\right)^2 - \left(\frac{1}{3}\right)^2 = \left(\frac{1}{2}m - \frac{1}{3}\right)\left(\frac{1}{2}m + \frac{1}{3}\right)$
49. $x^2 + x + \frac{1}{4} = x^2 + 2(x)\left(\frac{1}{2}\right) + \left(\frac{1}{2}\right)^2 = \left(x + \frac{1}{2}\right)^2$
50. $64g^2 - 192gh + 144h^2 = 16(4g^2 - 12gh + 9h^2) =$
$8[(2g)^2 - (3h)^2] = 8(2g + 3h)(2g - 3h)$
51. $\frac{1}{4}p^2 - 2p + 4 = \left(\frac{1}{2}p\right)^2 - 2\left(\frac{1}{2}p\right)2 + 2^2 = \left(\frac{1}{2}p - 2\right)^2$
52. $\frac{1}{9}n^2 - \frac{1}{25} = \left(\frac{1}{3}n\right)^2 - \left(\frac{1}{5}\right)^2 = \left(\frac{1}{3}n - \frac{1}{5}\right)\left(\frac{1}{3}n + \frac{1}{5}\right)$
53. $\frac{1}{25}k^2 + \frac{6}{5}k + 9 = \left(\frac{1}{5}k\right)^2 + 2\left(\frac{1}{5}k\right)3 + 3^2 = \left(\frac{1}{5}k + 3\right)^2$
54a. $(3.14n)n - 3.14m^2 = 3.14(n + m)(n - m)$
54b. $3.14(10 + 3)(10 - 3) = 3.14 \cdot 13 \cdot 7 = 285.74$;
285.74 in.^{2} **55a.** $4x^2 - 100 = 4(x^2 - 25) =$
$4(x + 5)(x - 5)$ **55b.** $4x^2 - 100 = (2x + 10)(2x - 10) =$
$4(x + 5)(x - 5)$ **55c.** There is only one result for the factoring of $4x^2 - 100$, but there are two different paths to that result, because $100 = 10^2$ and $\frac{100}{4} = 25 = 5^2$.
55d. No, because $3x^2 - 75$ is not a difference of squares.
56. $64r^6 - 144r^3 + 81 = (8r^3)^2 - 2 \cdot 8 \cdot 9r^3 + 9^2 =$
$(8r^3 - 9)^2$ **57.** $p^6 + 40p^3q + 400q^2 =$
$(p^3)^2 + 2(p^3q)20 + (20q)^2 = (p^3 + 20q)^2$
58. $36m^4 + 84m^2 + 49 = (6m^2)^2 + 2(6m^2)7 + 72 =$
$(6m^2 + 7)^2$ **59.** $81p^{10} + 198p^5 + 121 =$
$(9p^5)^2 + 2(9p^5)11 + 11^2 = (9p^5 + 11)^2$
60. $108m^6 - 147 = 3(36m^6 - 49) = 3[(6m^3)^2 - 72] =$
$3(6m^3 - 7)(6m^3 + 7)$ **61.** $x^{20} - 4x^{10}y^5 + 4y^{10} =$
$(x^{10})^2 - 2(x^{10})(2y^5) + (2y^5)^2 = (x^{10} - 2y^5)^2$
62. $256g^4 - 100h^6 = 4(64g^4 - 25h^6) =$
$4[(8g^2)^2 - (5h^3)^2] = 4(8g^2 - 5h^3)(8g^2 + 5h^3)$
63. $45x^4 - 60x^2y + 20y^2 = 5(9x^4 - 12x^2y + 4y^2) =$
$5[(3x^2)^2 - 2(3x^2)(2y) + (2y)^2] = 5(3x^2 - 2y)^2$
64. $37g^8 - 37h^8 = 37(g^8 - h^8) = 37(g^4 + h^4)(g^4 - h^4) =$
$37(g^4 + h^4)(g^2 + h^2)(g^2 - g^2) =$
$37(g^4 + h^4)(g^2 + h^2)(g + h)(g - h)$ **65a.** $(t - 3)^2 - 16 =$
$a^2 - b^2$; $a = t - 3$; $b = 4$ **65b.** $(t - 3)^2 - 16 =$
$[(t - 3) + 4][(t - 3) - 4] = (t + 1)(t - 7)$
66a. $16 - 81n^4 = (4 + 9n^2)(4 - 9n^2) =$
$(4 + 9n^2)(2 + 3n)(2 - 3n)$ **66b.** They are squares of square terms. **66c.** Answers may vary. Sample: $16x^4 - 1$
67. $4x^2 + 28x + 49 = (2x + 7)^2$; the answer is 9.
68. $x^2 - 24x + 144 = (x - 12)^2$; the answer is -12.
69. $225 = 15^2$; $k = 2 \cdot 15 = 30$; the answer is 30.
70. The green area + the purple area =
$4x^2 + 16x + 16 + 5x^2 + 14x + 9 = 9x^2 + 30x + 25 =$
$(3x + 5)^2$; the answer is 5. **71.** $144x^4 - 121 =$
$(12x^2)^2 - (11)^2 = (12x^2 - 11)(12x^2 + 11)$; the answer is 12. **72.** $81x^2 - 36 = 9(9x^2 - 4) = 9(3x + 2)(3x - 2)$;
$\frac{3 + 2}{2} = 2.5$; the answer is 2.5.

73. $2d^2$	$+ 11d$	$+ 5$
$2 \cdot 1$	$2 \cdot 1 + \quad 1 \cdot 5 = 7$	$5 \cdot 1$
$2 \cdot 1$	$2 \cdot 5 + \quad 1 \cdot 1 = 11$ ✓	$1 \cdot 5$

$(2d + 1)(d + 5) = 2d^2 + 11d + 5$

74. $2x^2 \quad -11x \quad +12$

$1 \cdot 2 \quad 1 \cdot -12 + -1 \cdot 2 = -14 \quad -1 \cdot -12$

$1 \cdot 2 \quad 1 \cdot -4 + -3 \cdot 2 = -10 \quad -3 \cdot -4$

$1 \cdot 2 \quad 1 \cdot -3 + -4 \cdot 2 = -11$ ✓ $\quad -4 \cdot -3$

$(x - 4)(2x - 3) = 2x^2 - 11x + 12$

75. $4t^2 \quad +16t \quad +7$

$4 \cdot 1 \quad 4 \cdot 1 + 1 \cdot 7 = 11 \quad 7 \cdot 1$

$4 \cdot 1 \quad 2 \cdot 7 + 1 \cdot 1 = 15 \quad 1 \cdot 7$

$2 \cdot 2 \quad 2 \cdot 1 + 2 \cdot 7 = 16$ ✓ $\quad 7 \cdot 1$

$(2t + 7)(2t + 1) = 4t^2 + 16t + 7$

76. $5w^2 \quad -44w \quad -9$

$5 \cdot 1 \quad 5 \cdot 1 + 1 \cdot -9 = -4 \quad -9 \cdot 1$

$5 \cdot 1 \quad 5 \cdot -9 + 1 \cdot 1 = -44$ ✓ $\quad 1 \cdot -9$

$(5w + 1)(w - 9) = 5w^2 - 44w - 9$

77. $6t^2 \quad +19t \quad +8$

$1 \cdot 6 \quad 1 \cdot 8 + 1 \cdot 6 = 14 \quad 1 \cdot 8$

$1 \cdot 6 \quad 1 \cdot 4 + 2 \cdot 6 = 16 \quad 2 \cdot 4$

$2 \cdot 3 \quad 2 \cdot 8 + 1 \cdot 3 = 19$ ✓ $\quad 1 \cdot 8$

$(2t + 1)(3t + 8) = 6t^2 + 19t + 8$

78. $21m^2 \quad -20m \quad -9$

$3 \cdot 7 \quad 3 \cdot 1 + 7 \cdot -9 = -60 \quad -9 \cdot 1$

$3 \cdot 7 \quad 3 \cdot -9 + 7 \cdot 1 = -20$ ✓ $\quad 1 \cdot -9$

$(3m + 1)(7m - 9) = 3m^2 - 20m - 9$

79. $14x^2 \quad -11x \quad -9$

$2 \cdot 7 \quad 2 \cdot 1 + 7 \cdot -9 = -61 \quad -9 \cdot 1$

$2 \cdot 7 \quad 2 \cdot -9 + 7 \cdot 1 = -11$ ✓ $\quad 1 \cdot -9$

$(2x + 1)(7x - 9) = 14x^2 - 11x - 9$

80. $4y^2 \quad +32y \quad +55$

$2 \cdot 2 \quad 2 \cdot 11 + 5 \cdot 2 = 32$ ✓ $\quad 5 \cdot 11$

$(2y + 5)(2y + 11) = 4y^2 + 32y + 55$

81. $12k^2 \quad -5k \quad -2$

$3 \cdot 4 \quad 3 \cdot -2 + 4 \cdot 1 = -2 \quad 1 \cdot -2$

$3 \cdot 4 \quad 3 \cdot 1 + 4 \cdot -2 = -5$ ✓ $\quad -2 \cdot 1$

$(3k - 2)(4k + 1) = 12k^2 - 5k - 2$

82. $768, 3072, 12{,}288; 3 \cdot 4^{n-1}$ **83.** $29, 37, 45; -11 + 8n$ **84.** $-11, -20, -29; 34 - 9n$ **85.** $0.02, 0.002, 0.0002; 2000 \cdot (0.1)^n$ **86.** $-32, 64, -128; (-2)^n$ **87.** $129.6, 777.6, 4665.6; 0.1(6)^{n-1}$ **88.** $\frac{32}{125}, \frac{64}{625}, \frac{128}{3125}; 10 \cdot \left(\frac{2}{5}\right)^{n-1}$ **89.** $6\frac{1}{2}, 8, 9\frac{1}{2}; -1 + \frac{3}{2}n$ **90.** $8, 32, 128; \frac{1}{32} \cdot 4^{n-1}$ **91a.** Let x = hours studying, y = grade. Calculator gives $y = 11.4x + 64.8$

91b. $11.4(2.5) + 64.8 = 93.3; 93$

91c. $11.4(1.25) + 64.8 = 79.05; 79$

CHECKPOINT QUIZ 2 *page 495*

1. $(k - 7)^2 = k^2 - 2(k)7 + 7^2 = k^2 - 14k + 49$

2. $(5t + 9)^2 = (5t)2 + 2(5t)9 + 9^2 = 25t^2 + 90t + 81$

3. $(h - 11)(h - 11) = h^2 - 2(h)11 + 11^2 = h^2 - 22h + 121$ **4.** $v^2 + 20v + 100 = v^2 + 2(v)10 + 102 = (v + 10)^2$ **5.** $-10 \cdot 4 = -40; -10 + 4 = -6; p^2 - 6p - 40 = (p - 10)(p + 4)$

6. $-12 \cdot -5 = 60; -12 + (-5) = -17; k^2 - 17k + 60 = (k - 12)(k - 5)$

7. $2x^2 \quad +13x \quad +11$

$2 \cdot 1 \quad 2 \cdot 11 + 1 \cdot 1 = 23 \quad 1 \cdot 11$

$2 \cdot 1 \quad 2 \cdot 1 + 1 \cdot 11 = 13$ ✓ $\quad 11 \cdot 1$

$(2x + 11)(x + 1) = 2x^2 + 13x + 11$

8. $10m^2 \quad +19m \quad +7$

$2 \cdot 5 \quad 2 \cdot 1 + 7 \cdot 5 = 37 \quad 7 \cdot 1$

$2 \cdot 5 \quad 2 \cdot 7 + 5 \cdot 1 = 19$ ✓ $\quad 1 \cdot 7$

$(2m + 1)(5m + 7) = 2m^2 + 19m + 7$

9. $3w^2 - 6w - 24 = 3(w^2 - 2w - 8) = 3(w - 4)(w + 2)$

10. $9t^2 - 25 = (3t)^2 - 5^2 = (3t - 5)(3t + 5)$

9-8 Factoring by Grouping *pages 496–501*

Check Skills You'll Need p. 496 For complete solutions see *Daily Skills Check and Lesson Quiz Transparencies* or *Presentation Pro CD-ROM.*

1. 2 **2.** $3r$ **3.** $5h$ **4.** $4m$ **5.** $v^3 + 3v^2 + 5v + 15$ **6.** $2q^3 - 10q^2 - 4q + 20$ **7.** $6t^2 - 7t - 20$ **8.** $4x^3 + 7x^2 + 10x - 3$

Check Understanding 1a. $5t^4 + 20t^3 + 6t + 24 = 5t^3(t + 4) + 6(t + 4) = (5t^3 + 6)(t + 4) = 5t^4 + 20t^3 + 6t + 24$ ✓ **1b.** $2w^3 + w^2 - 14w - 7 = w^2(2w + 1) - 7(2w + 1) = (w^2 - 7)(2w + 1) = 2w^3 + w^2 - 14w - 7$ ✓ **2.** $45m^4 - 9m^3 + 30m^2 - 6m = 3m(15m^3 - 3m^2 + 10m - 2) = 3m[3m^2(5m - 1) + 2(5m - 1)] = 3m(3m^2 + 2)(5m - 1)$ **3a.** $ac = 63 \cdot 5 = 315 = 3 \cdot 105 = 5 \cdot 63 = 7 \cdot 45 = 9 \cdot 35; 9 + 35 = 44; 63d^2 + (9 + 35)d + 5 = 63d^2 + 9d + 35d + 5 = 9d(7d + 1) + 5(7d + 1) = (9d + 5)(7d + 1)$ **3b.** $ac = 11 \cdot 20 = 220 = 4 \cdot 55 = 5 \cdot 44; 5 + 44 = 49; 11k^2 + 49k + 20 = 11k^2 + (5 + 44)k + 20 = 11k^2 + 5k + 44k + 20 = k(11k + 5) + 4(11k + 5) = (k + 4)(11k + 5)$ **3c.** $ac = 4 \cdot -70 = -280 = 8 \cdot -35 = 40 \cdot -7; 40 + (-7) = 33; 4y^2 + 33y - 70 = 4y^2 + (40 - 7)y - 70 = 4y^2 + 40y - 7y - 70 = 4y(y + 10) - 7(y + 10) = (4y - 7)(y + 10)$ **4a.** $6g^3 + 20g^2 + 16g = 2g(3g^2 + 10g + 8) = 2g(3g + 4)(g + 2)$; dimensions are $2g, 3g + 4$, and $g + 2$. **4b.** $3m^3 + 10m^2 + 3m = m(3m^2 + 10m + 3) = m(3m + 1)(m + 3)$; dimensions are m, $3m + 1$, and $m + 3$.

Exercises 1. $2m^2, 3$ **2.** $5p^2, 2$ **3.** $2z^2, -5$ **4.** $3n^2, 1$ **5.** $6n^3 + 8n^2 + 3n + 4 = 2n^2(3n + 4) + (3n + 4) = (2n^2 + 1)(3n + 4)$ **6.** $14t^3 + 21t^2 + 16t + 24 = 7t^2(2t + 3) + 8(2t + 3) = (7t^2 + 8)(2t + 3)$ **7.** $27t^3 + 45t^2 - 3t - 5 = 9t^2(3t + 5) - (3t + 5) = (9t^2 - 1)(3t + 5) = (3t + 1)(3t - 1)(3t + 5)$ **8.** $13y^3 - 8y^2 + 13y - 8 = y^2(13y - 8) + (13y - 8) = (y^2 + 1)(13y - 8)$ **9.** $45x^3 + 20x^2 + 9x + 4 = 5x^2(9x + 4) + (9x + 4) = (5x^2 + 1)(9x + 4)$ **10.** $10w^3 + 16w^2 - 15w - 24 = 2w^2(5w + 8) - 3(5w + 8) = (2w^2 - 3)(5w + 8)$ **11.** $12v^3 - 32v^2 + 6v - 16 = 2(6v^3 - 16v^2 + 3v - 8) = 2[2v^2(3v - 8) + (3v - 8)] = 2(2v^2 + 1)(3v - 8)$ **12.** $7q^4 - 4q^3 + 28q^2 - 16q = q(7q^3 - 4q^2 + 28q - 16) = q[q^2(7q - 4) + 4(7q - 4)] = q(q^2 + 4)(7q - 4)$

13. $20m^3 - 18m^2 + 40m - 36 =$
$2(10m^3 - 9m^2 + 20m - 18) =$
$2[m^2(10m - 9) + 2(10m - 9) = 2(m^2 + 2)(10m - 9)$
14. $6x^4 + 4x^3 - 6x^2 - 4x = 2x(3x^3 + 2x^2 - 3x - 2) =$
$2x[x^2(3x + 2) - (3x + 2)] = 2x(x^2 - 1)(3x + 2) =$
$2x(x + 1)(x - 1)(3x + 2)$ **15.** $12y^3 - 20y^2 + 30y - 50 =$
$2(6y^3 - 10y^2 + 15y - 25) =$
$2[2y^2(3y - 5) + 5(3y - 5)] = 2(2y^2 + 5)(3y - 5)$
16. $9c^3 - 12c^2 + 18c - 24 = 3(3c^3 - 4c^2 + 6c - 8) =$
$3[c^2(3c - 4) + 2(3c - 4)] = 3(c^2 + 2)(3c - 4)$
17. $12p^2 + 16p + 5 = (6p + 5)(2p + 1)$ **18.** $16 \cdot 9 =$
$144 = 12 \cdot 12; 12 + 12 = 24; 16t^2 + 12t + 12t + 9 =$
$4t(4t + 3) + 3(4t + 3) = (4t + 3)^2$ **19.** $18 \cdot -10 =$
$60 \cdot -3; 60 + (-3) = 57; 18n^2 + 60n - 3n - 10 =$
$6n(3n + 10) - (3n + 10) = (6n - 1)(3n + 10)$
20. $-9 \cdot -20 = -3 \cdot -60 = -12 \cdot -15; -12 + (-15) =$
$-27; 9w^2 - 12w - 15w + 20 = 3w(3w - 4) - 5(3w - 4) =$
$(3w - 5)(3w - 4)$ **21.** $24m^2 + 8m - 2 =$
$2(12m + 4m - 1) = 2(6m - 1)(2m + 1)$ **22.** $36 \cdot -7 =$
$12 \cdot -21; 12 - 21 = -9; 36v^2 + 12v - 21v - 7 =$
$12v(3v + 1) - 7(3v + 1) = (12v - 7)(3v + 1)$
23. $6 \cdot -10 = -60 = -4 \cdot 15; -4 + 15 = 11;$
$6x^2 + 11x - 10 = 6x^2 - 4x + 15x - 10 =$
$2x(3x - 2) + 5(3x - 2) = (2x + 5)(3x - 2)$
24. $-20 \cdot -9 = -5 \cdot -36; -5 + (-36) =$
$-41; 20v^2 - 5v - 36v + 9 = 5v(4v - 1) - 9(4v - 1) =$
$(5v - 9)(4v - 1)$ **25.** $63 \cdot -20 = 7 \cdot -180 =$
$12 \cdot -105 = 15 \cdot -84 = 18 \cdot -70; 18 - 70 = -52;$
$63q^2 + 18q - 70q - 20 = 9q(7q + 2) - 10(7q + 2) =$
$(9q - 10)(7q + 2)$ **26.** $3m^3 + 7m^2 + 2m =$
$m(3m^2 + 7m + 2) = m(3m + 1)(m + 2)$; dimensions are $m, 3m + 1$, and $m + 2$. **27.** $5k^3 + 30k^2 + 40k =$
$5k(k^2 + 6k + 8) = 5k(k + 2)(k + 4)$ dimensions are $5k$, $k + 2$, and $k + 4$. **28.** $7h^3 - 35h^2 - 42h =$
$7h(h^2 - 5h - 6) = 7h(h + 1)(h - 6)$
29. $60t^3 - 200t^2 - 66t + 220 =$
$2(30t^3 - 100t^2 - 33t + 110) =$
$2[10t^2(3t - 10) - 11(3t - 10)] = 2(10t^2 - 11)(3t - 10)$
30. $8d^3 + 16d^2 + 24d + 48 = 8(d^3 + 2d^2 + 3d + 6) =$
$8[d^2(d + 2) + 3(d + 2)] = 8(d^2 + 3)(d + 2)$
31. $12x^2 - 4xy - 56y^2 = 4(3x^2 - xy - 14y^2) =$
$4(3x - 7y)(x + 2y)$ **32.** $54r^3 - 45r^2 + 9r =$
$9r(6r^2 - 5r + 1) = 9r(3r - 1)(2r - 1)$
33. $150k^3 + 350k^2 + 180k + 420 =$
$10(15k^3 + 35k^2 + 18k + 42) =$
$10[5k^2(3k + 7) + 6(3k + 7)] = 10(5k^2 + 6)(3k + 7)$
34a. $(28x^3 - 7x^2) + (36x - 9) =$
$7x^2(4x - 1) + 9(4x - 1) = (7x^2 + 9)(4x - 1)$
34b. $(28x^3 + 36x) + (-7x^2 - 9) =$
$4x(7x^2 + 9) - (7x^2 + 9) = (4x - 1)(7x^2 + 9)$
34c. Answers may vary. Sample: The sequence of the final factors may vary, but the final results are equivalent. **35.** $14w^3 + 49w^2 - 8w - 28 =$
$7w^2(2w^2 + 7) - 4(2w + 7) = (7w^2 - 4)(2w^2 + 7)$
36. $2m^3 - 32m^2 - m + 16 = 2m^2(m - 16) - (m - 16) =$
$(2m^2 - 1)(m - 16)$ **37.** $44t^3 - 4t^2 + 66t - 6 =$
$2(22t^3 - 2t^2 + 33t - 3) = 2[2t^2(11t - 1) + 3(11t - 1)] =$
$2(2t^2 + 3)(11t - 1)$ **38.** $25x^3 - x^2 - 50x + 2 =$
$x^2(25x - 1) - 2(25x - 1) = (x^2 - 2)(25x - 1)$

39. $84w^3 + 82w^2 + 10w = 2w(42w^2 + 41w + 5) =$
$2w(6w + 5)(7w + 1)$; the dimensions are $2w, 6w + 5$, and $7w + 1$. **40.** The easiest way to do this is to start with the factors. Sample: $(2x^2 + 1)(x + 3) = 2x^3 + 6x^2 + x + 3 =$
$2x^2(x + 3) + (x + 3) = (2x^2 + 1)(x + 3)$
41. $10x^3 - 15x^2 + 2x - 3$; factor the first two terms.
$= 5x^2(2x - 3) + (2x - 3)$; notice the repeated factor.
$= (5x^2 + 1)(2x - 3)$; factor out $(2x - 3)$.
42. $30m^5 + 24m^3n - 35m^2n^2 - 28n^3 =$
$6m^3(5m^2 + 4n) - 7n^2(5m^2 + 4n) =$
$(6m^3 - 7n^2)(5m^2 + 4n)$ **43.** $x^2p + x^2q^5 + yp + yq^5 =$
$x^2(p + q^5) + y(p + q^5) = (x^2 + y)(p + q^5)$
44. $h^3 + 11h^2 - 4h - 44 = h^2(h + 11) - 4(h + 11) =$
$(h^2 - 4)(h + 11) = (h + 2)(h - 2)(h + 11)$
45. $w^6 - w^4 - 9w^2 + 9 = w^4(w^2 - 1) - 9(w^2 - 1) =$
$(w^4 - 9)(w^2 - 1) = (w^2 + 3)(w^2 - 3)(w + 1)(w - 1)$
46a. $2\pi x^3 + 12\pi x^2 + 18\pi x = 2\pi x(x^2 + 6x + 9) =$
$2\pi x(x + 3)^2$ **46b.** $V = \pi r^2 h; h = 2x; r = (x + 3)$
47. $(2^5 + 2^4 + 2^3) + (2^2 + 2^1 + 2^0) = 2^3(2^2 + 2^1 + 2^0) +$
$(2^2 + 2^1 + 2^0) = (2^3 + 2^0)(2^2 + 2^1 + 2^0) = (9)(7)$
48. $(2^5 + 2^4) + (2^3 + 2^2) + (2^1 + 2^0) =$
$2^4(2^1 + 2^0) + 2^2(2^1 + 2^0) + (2^1 + 2^0) =$
$(2^4 + 2^2 + 2^0)(2^1 + 2^0) = (21)(3)$ **49a.** Answers may vary. Sample: width $= x$; height $= x + 4$; length $= 2x + 4$
49b. volume $= x(x + 4)(2x + 4) = x(2x^2 + 12x + 16) =$
$2x^3 + 12x^2 + 16x$ **50.** $27x^4 + 15x^3 + 63x + 35 =$
$3x^3(9x + 5) + 7(9x + 5) = (3x^3 + 7)(9x + 5)$; the answer is C. **51.** $6q^3 - 5q^2 + 24q - 20 =$
$q^2(6q - 5) + 4(6q - 5) = (q^2 + 4)(6q - 5);$
$(q^2 + 4) + (6q - 5) = q^2 + 6q - 1$; the answer is H.
52. [2] $9a^4 - 54a^3 - 2a + 12 = 9a^3(a - 6) - 2(a - 6) =$
$(9a^3 - 2)(a - 6)$ [1] one computational error
53. [4] $96x^3 + 48x^2 + 6x = 6x(16x^2 + 8x + 1) =$
$6x(4x + 1)^2$; side of square measures $(4x + 1)$; perimeter $= 4(4x + 1) = 16x + 4$ [3] one error in factoring
[2] found factors of polynomial, but did not find perimeter [1] no work shown
54. $k^2 + 14k + 49 = k^2 + 2(k)7 + 7^2 = (k + 7)^2$
55. $r^2 + 6r + 9 = r^2 + 2(r)3 + 32 = (r + 3)^2$
56. $y^2 - 16y + 64 = y^2 - 2(y)8 + 8^2 = (y - 8)^2$
57. $2t^2 + 12t + 18 = 2(t^2 + 6t + 9) =$
$2[t^2 + 2(t)3 + 32] = 2(t + 3)^2$ **58.** $m^2 - 64 =$
$m^2 - 8^2 = (m - 8)(m + 8)$ **59.** $4g^2 + 40g + 100 =$
$4(g^2 + 10g + 25) = 4[g^2 + 2(g)5 + 5^2] = 4(g + 5)^2$
60. $4d^2 - 25 = (2d)^2 - 5^2 = (2d - 5)(2d + 5)$
61. $5n^2 - 45 = 5(n^2 - 9) = 5(n^2 - 3^2) =$
$5(n - 3)(n + 3)$ **62.** $25q^2 + 40q + 16 =$
$(5q)^2 + 2(5q)4 + 4^2 = (5q + 4)^2$ **63.** $(b^2)^2 = b^{2 \cdot 2} = b^4$
64. $x^4 \cdot x^{-2} = x^{4+(-2)} = x^2$ **65.** $(t^3)^5 = t^{3 \cdot 5} = t^{15}$
66. $(c^5d)^7 = (c^5)^7d^7 = c^{5 \cdot 7}\, d^7 = c^{35}d^7$ **67.** $(2y)^3 =$
$2^3y^3 = 8y^3$ **68.** $(9m)^0 = 1$ **69.** $(x^3)(x^7)^{-2} = x^3x^{7 \cdot -2} =$
$x^3x^{-14} = x^{-11} = \frac{1}{x^{11}}$ **70.** $(3w^2v^3)^4 = 3^4w^8v^{12} =$
$81w^8v^{12}$ **71.** $(2 \times 10^5)^4 = 2^4 \cdot (10^5)^4 = 16 \cdot 10^{5 \cdot 4} =$
$16 \cdot 10^{20} = 1.6 \times 10^{21}$ **72.** $(3 \times 10^6)^2 = 3^2 \cdot 10^{6 \cdot 2} =$
9×10^{12} **73.** $(7 \times 10^{-6})^2 = 49 \cdot 10^{-12} = 4.9 \times 10^{-11}$
74. $(2 \times 10^7)^5 = 32 \cdot 10^{35} = 3.2 \times 10^{36}$
75. $(5.3 \times 10^2)^2 = 5.3^2 \cdot 10^4 = 28.09 \cdot 10^4 =$

2.809×10^5 **76.** $(8.1 \times 10^{-3})^2 = 8.1^2 \cdot 10^{-6} = 65.61 \cdot 10^{-6} = 6.561 \times 10^{-5}$ **77.** $(1.9 \times 10^8)^3 = 1.9^3 \cdot 10^{24} = 6.859 \times 10^{24}$ **78.** $(4 \times 10^{-3})^{-2} = 4^{-2} \cdot 10^6 = 0.0625 \cdot 10^6 = 6.25 \times 10^4$

79.
$$\begin{aligned} -7x + 12 &= 3x + 2 \\ -10x + 12 &= 2 \\ -10x &= -10 \\ x &= 1 \\ y &= 3 \cdot 1 + 2 = 5 \end{aligned}$$

80.
$$\begin{aligned} -3x + 4 &= -5x + 12 \\ 2x + 4 &= 12 \\ 2x &= 8 \\ x &= 4 \\ y &= -3 \cdot 4 + 4 = -8 \end{aligned}$$

81.
$$\begin{aligned} y &= -4x + 7 \\ 10x + 2y &= 15 \\ 10x + 2(-4x + 7) &= 15 \\ 10x - 8x + 14 &= 15 \\ 2x + 14 &= 15 \\ 2x &= 1 \\ x &= 0.5 \\ y &= -4 \cdot 0.5 + 7 = 5 \end{aligned}$$

82.
$$\begin{aligned} y &= -2x - 26 \\ x + y &= -28 \\ x + (-2x - 26) &= -28 \\ -x - 26 &= -28 \\ -x &= -2 \\ x &= 2 \\ y &= -2 \cdot 2 - 26 = -30 \end{aligned}$$

83.
$$\begin{aligned} 8x + 2y &= 50 \\ 2y &= -8x + 50 \\ y &= -4x + 25 \end{aligned}$$

The two equations are identical. There are infinitely many solutions (x, y) which satisfy $y = -4x + 25$.

84.
$$\begin{aligned} y &= x - 5 \\ 11x - 6y &= 65 \\ 11x - 6(x - 5) &= 65 \\ 5x + 30 &= 65 \\ 5x &= 35 \\ x &= 7 \\ y &= 7 - 5 = 2 \end{aligned}$$

TEST-TAKING STRATEGIES *page 502*

1. B. $(x - 1)(x^2 + 2x + 3) = x^3 + x^2 + x - 3$ **D.** $(x - 1)(x^2 - 2x + 3) = x^3 - 3x^2 + 5x - 3$; the answer is B. **2.** $5(-2) = -10$, whereas B has -2 for the constant term. **3a.** The correct answer must have a constant term of $+6$. **3b.** G and I differ in the sign of the middle term. Use mental math to get the x^2 term in the product. **G.** $-3x^2 + 5x^2 = 2x^2$ ✓ **I.** $-3x^2 - 5x^2 = -8x^2$; the answer is G.

CHAPTER REVIEW *pages 503–505*

1. A **2.** D **3.** E **4.** C **5.** B **6.** $-6y^2 + 8y + 2$; quadratic trinomial **7.** $9h^2 + 1$; quadratic binomial **8.** $3k^5 + k$; fifth-degree binomial **9.** $7t^2 + 8t + 9$; quadratic trinomial **10.** x^2y^2; fourth-degree monomial **11.** $x^3 + x^2 + 5$; cubic trinomial **12.** Answers may vary. Sample: $3z^4 - 5z^2 + 1$; 4 **13.** $(-4b^5 + 3b^3 - b + 10) + (3b^5 - b^3 + b - 4) = (-4 + 3)b^5 + (3 - 1)b^3 + (-1 + 1)b + (10 - 4) = -b^5 + 2b^3 + 6$ **14.** $(3g^4 + 5g^2 + 5) + (5g^4 - 10g^2 + 11g) = (3 + 5)g^4 + (5 - 10)g^2 + 11g + 5 = 8g^4 - 5g^2 + 11g + 5$ **15.** $(3x^3 + 8x^2 + 2x + 9) - (-4x^3 + 5x - 3) = [3 - (-4)]x^3 + 8x^2 + (2 - 5)x + 9 - (-3) = 7x^3 + 8x^2 - 3x + 12$ **16.** $(2t^3 - 4t^2 + 9t - 7) - (t^3 + t^2 - 3t + 1) = (2 - 1)t^3 + (-4 - 1)t^2 + [9 - (-3)]t - 7 - 1 = t^3 - 5t^2 + 12t - 8$ **17.** $(6y^2 + 3y + 5) - (2y^2 + 1) = (6 - 2)y^2 + 3y + (5 - 1) = 4y^2 + 3y + 4$ **18.** $(7w^5 - 7w^3 + 3w) - (5w^4 - w^2 + 3) = (7w^5 - 5w^4 - 7w^3 + w^2 + 3w - 3$ **19.** $8x(2 - 5x) = 8x(2) - 8x(5x) = 16x - 40x^2 = -40x^2 + 16x$ **20.** $5g(3g + 7g^2 - 9) = 5g(3g) + 5g(7g^2) - 5g(9) = 15g^2 + 35g^4 - 45g = 35g^4 + 15g^2 - 45g$ **21.** $8t^2(3t - 4 - 5t^2) = 8t^2(3t) - 8t^2(4) - 8t^2(5t^2) = 24t^3 - 32t^2 - 40t^4 = -40t^4 + 24t^3 - 32t^2$ **22.** $5m(3m + m^2) = 5m(3m) + 5m(m^2) = 15m^2 + 5m^3 = 5m^3 + 15m^2$ **23.** $-2w^2(4w - 10 + 3w^2) = -2w^2(4w) - 2w^2(-10) - 2w^2(3w^2) = -8w^3 + 20w^2 - 6w^4 = -6w^4 - 8w^3 + 20w^2$ **24.** $b(10 + 5b - 3b^2) = b(10) + b(5b) - b(3b^2) = 10b + 5b^2 - 3b^3 = -3b^3 + 5b^2 + 10b$ **25.** $9x^4 = 3 \cdot 3 \cdot x^4$; $12x^3 = 3 \cdot 2 \cdot 2 \cdot x^3$; $6x = 3 \cdot 2 \cdot x$; $GCF = 3x$; $9x^4 + 12x^3 + 6x = 3x(3x^3 + 4x^2 + 2)$ **26.** $4t^5 = 2 \cdot 2 \cdot t^5$; $12t^3 = 3 \cdot 2 \cdot 2 \cdot t^3$; $8t^2 = 2 \cdot 2 \cdot 2 \cdot t^2$; $GCF = 4t^2$; $4t^5 - 12t^3 + 8t^2 = 4t^2(t^3 - 3t + 2)$ **27.** $40n^5 = 5 \cdot 2 \cdot 2 \cdot 2 \cdot n^5$; $70n^4 = 7 \cdot 5 \cdot 2 \cdot n^4$; $30n^3 = 5 \cdot 3 \cdot 2 \cdot n^3$; $GCF = 10n^3$; $40n^5 + 70n^4 - 30n^3 = 10n^3(4n^2 + 7n - 3)$ **28.** $2k^4 = 2 \cdot k^4$; $4k^3 = 2 \cdot 2 \cdot k^3$; $6k = 3 \cdot 2 \cdot k$; $8 = 2 \cdot 2 \cdot 2$; $GCF = 2$; $2k^4 + 4k^3 - 6k - 8 = 2(k^4 + 2k^3 - 3k - 4)$ **29.** $3d^2 = 3 \cdot d^2$; $6d = 3 \cdot 2 \cdot d$; $GCF = 3d$; $3d^2 - 6d = 3d(d - 2)$ **30.** $10m^4 = 5 \cdot 2 \cdot m^4$; $12m^3 = 3 \cdot 2 \cdot 2 \cdot m^3$; $4m^2 = 2 \cdot 2 \cdot m^2$; $GCF = 2m^2$; $10m^4 - 12m^3 + 4m^2 = 2m^2(5m^2 - 6m + 2)$ **31.** $10v = 5 \cdot 2 \cdot v$; $5 = 5$; $GCF = 5$; $10v - 5 = 5(2v - 2)$ **32.** $12w^3 = 3 \cdot 2 \cdot 2 \cdot w^3$; $8w^2 = 2 \cdot 2 \cdot 2 \cdot w^2$; $20w = 5 \cdot 2 \cdot 2 \cdot w$; $GCF = 4w$; $12w^3 + 8w^2 + 20w = 4w(3w^2 + 2w + 5)$ **33.** $18d^5 = 3 \cdot 3 \cdot 2 \cdot d^5$; $6d^4 = 3 \cdot 2 \cdot d^4$; $9d^3 = 3 \cdot 3 \cdot d^3$; $GCF = 3d^3$; $18d^5 + 6d^4 + 9d^3 = 3d^3(6d^2 + 2d + 3)$ **34.** 12; if the GCF of x and y is 3, then the GCF of $4x$ and $3y$ is $4 \cdot 3 = 12$. **35.** $8m^2n = 4mn(m)$ and $4mn = 4mn(1)$, so their GCF is $4mn$. Kim is correct. **36.** $(x + 3)(x + 5) = x^2 + 5x + 3x + 15 = x^2 + 8x + 15$ **37.** $(5v + 2)(3v - 7) = 15v^2 - 35v + 6v - 14 = 15v^2 - 29v - 14$ **38.** $(2b + 5)(3b - 2) = 6b^2 - 4b + 15b - 10 = 6b^2 + 11b - 10$ **39.** $(k - 1)(-k + 4) = -k^2 + 4k + k - 4 = -k^2 + 5k - 4$ **40.** $(p + 2)(p^2 + p + 1) = p^3 + p^2 + p + 2p^2 + 2p + 2 = p^3 + 3p^2 + 3p + 2$ **41.** $(4a - 1)(a - 5) = 4a^2 - 20a - a + 5 = 4a^2 - 21a + 5$ **42.** $(y - 4)(y^2 - 5y - 2) = y^3 - 5y^2 - 2y - 4y^2 + 20y + 8 = y^3 - 9y^2 + 18y + 8$

43. $(3x + 4)(x + 2) = 3x^2 + 6x + 4x + 8 = 3x^2 + 10x + 8$
44. $(-2h^2 + h - 1)(h - 5) -2h^3 + 10h^2 + h^2 - 5h - h + 5 = -2h^3 + 11h^2 - 6h + 5$ **45.** $(q - 4)(q - 4) = q^2 - 2(q)4 + 4^2 = q^2 - 8q + 16$ **46.** $(2k^3 + 5)^2 = (2k^3)^2 + 2(2k^3)5 + 5^2 = 4k^6 + 20k^3 + 25$
47. $(8 - 3t^2)(8 + 3t^2) = 8^2 - (3t^2)^2 = 64 - 9t^4$
48. $(2m^2 + 5)(2m^2 - 5) = (2m^2)^2 - 5^2 = 4m^4 - 25$
49. $(w - 4)(w + 4) = w^2 - 4^2 = w^2 - 16$
50. $(4g^2 - 5h^4)(4g^2 + 5h^4) = (4g^2)^2 - (5h^4)^2 = 16g^4 - 25h^8$ **51.** Area $= (2x + 1)(x + 4) = 2x^2 + 9x + 4$
52. No; $(x - y)^2 = x^2 - 2xy + y^2 \neq x^2 - y^2$. **53.** $1 \cdot 2 = 2; 1 + 2 = 3; x^2 + 3x + 2 = (x + 2)(x + 1)$
54. $-7 \cdot -2 = 14; -7 + (-2) = -9; y^2 - 9y + 14 = (y - 7)(y - 2)$ **55.** $-5 \cdot 3 = -15; -5 + 3 = -2;$ $x^2 - 2x - 15 = (x - 5)(x + 3)$

56.

$2w^2$	$- w$		$- 3$
$2 \cdot 1$	$2 \cdot -3 +$	$1 \cdot 1 = -4$	$1 \cdot -3$
$2 \cdot 1$	$2 \cdot 1 +$	$1 \cdot -3 = -1$ ✓	$-3 \cdot 1$

$(2w + 1)(w - 3) = 2w^2 - w - 3$

57. $b^2 - 7b + 12 = (b - 3)(b - 4)$

58.

$2t^2$	$+ 3t$		$- 2$
$2 \cdot 1$	$2 \cdot -2 +$	$1 \cdot 1 = -3$	$1 \cdot -2$
$2 \cdot 1$	$2 \cdot 1 +$	$1 \cdot -2 = 0$	$-2 \cdot 1$
$2 \cdot 1$	$2 \cdot 2 +$	$1 \cdot -1 = 3$ ✓	$-1 \cdot 2$

$(2t - 1)(t + 2) = 2t^2 + 3t - 2$

59. $x^2 + 5x - 6 = (x + 6)(x - 1)$ **60.** $6x^2 + 10x + 4 = 2(3x^2 + 5x + 2) = 2(3x + 2)(x + 1)$ **61.** $21 \cdot -8 = 3 \cdot -56 = 4 \cdot -42 = 6 \cdot -28; 6 + (-28) = -22; 21x^2 + 6x - 28x - 8 = 3x(7x + 2) - 4(7x + 2) = (3x - 4)(7x + 2)$

62.

$3x^2$	$+ x$		$- 2$
$3 \cdot 1$	$3 \cdot -2 +$	$1 \cdot 1 = -5$	$1 \cdot -2$
$3 \cdot 1$	$3 \cdot 1 +$	$1 \cdot -2 = 1$ ✓	$-2 \cdot 1$

$(3x - 2)(x + 1) = 3x^2 + x - 2$

63.

$15y^2$	$+ 16y$		$+ 1$
$15 \cdot 1$	$15 \cdot 1 +$	$1 \cdot 1 = 16$ ✓	$1 \cdot 1$

$(15y + 1)(y + 1) = 15y^2 + 16y + 1$

64.

$15y^2$	$- 16y$		$+ 1$
$15 \cdot 1$	$15 \cdot 1 +$	$1 \cdot 1 = 16$	$1 \cdot 1$
$15 \cdot 1$	$15 \cdot -1 +$	$1 \cdot -1 = -16$ ✓	$-1 \cdot -1$

$(15y - 1)(y - 1) = 15y^2 - 16y + 1$

65. $q^2 + 2q + 1 = q^2 + 2(q)1 + 1^2 = (q + 1)^2$
66. $b^2 - 16 = b^2 - 4^2 = (b + 4)(b - 4)$
67. $x^2 - 4x + 4 = x^2 - 2(x)2 + 2^2 = (x - 2)^2$
68. $4t^2 - 121 = (2t)^2 - 11^2 = (2t - 11)(2t + 11)$
69. $4d^2 - 20d + 25 = (2d)^2 - 2(4d)5 + 5^2 = (2d - 5)^2$
70. $9c^2 + 6c + 1 = (3c)^2 + 2(3c)1 + 12 = (3c + 1)^2$
71. $9k^2 - 25 = (3k)^2 - 5^2 = (3k - 5)(3k + 5)$
72. $x^2 + 6x + 9 = x^2 + 2(x)3 + 3^2 = (x + 3)^2$
73. $24y^2 - 6 = 6(4y^2 - 1) = 6[(2y)^2 - 1^2] = 6(2y - 1)(2y + 1)$ **74.** $\frac{1}{4}d^2 + d + 1 = \left(\frac{1}{2}d\right)^2 + 2\left(\frac{1}{2}d\right)1 + 1^2 = \left(\frac{1}{2}d + 1\right)^2$; side has length $\frac{1}{2}d + 1$. **75.** The factors are equal. **76.** No; only the square $(5u + 6)^2$ would have $25u^2$ and 36 as the first and last terms; however, $2(5u)(6) \neq 65u$. **77.** $4x^2$; -2 **78.** $3k^2$; -2 **79.** $24y^2$; -4 **80.** $10n^3$; 7
81. $6x^3 + 3x^2 + 8x + 4 = 3x^2(2x + 1) + 4(2x + 1) = (3x^2 + 4)(2x + 1)$ **82.** $20y^4 - 45y^2 = 5y^2(4y^2 - 9) = 5y(2y + 3)(2y - 3)$ **83.** $9g^2 + 15g - 6 = 3(3g^2 + 5g - 2) = 3(3g - 1)(g + 2)$

84.

$6c^2$	$- 5cd$		$+ d^2$
$6 \cdot 1$	$6 \cdot -1 +$	$1 \cdot -1 = -7$	$-1 \cdot -1$
$3 \cdot 2$	$3 \cdot -1 +$	$2 \cdot -1 = -5$ ✓	$-1 \cdot -1$

$(3c - d)(2c - d) = 6c^2 - 5cd + 1$

85.

$11k^2$	$+ 23k$		$+ 2$
$11 \cdot 1$	$11 \cdot 1 +$	$1 \cdot 2 = 13$	$2 \cdot 1$
$1 \cdot 11$	$1 \cdot 1 +$	$11 \cdot 2 = 23$ ✓	$2 \cdot 1$

$(11k + 1)(k + 2) = 11k^2 + 23k + 2$

86. $3u^2 + 21u + 18 = 3(u^2 + 7u + 6) = 3(u + 1)(u + 6)$

87.

$15p^2$	$+ 14p$		$+ 3$
$15 \cdot 1$	$15 \cdot 1 +$	$1 \cdot 3 = 18$	$3 \cdot 1$
$3 \cdot 5$	$3 \cdot 1 +$	$5 \cdot 3 = 18$	$3 \cdot 1$
$3 \cdot 5$	$3 \cdot 3 +$	$5 \cdot 1 = 14$ ✓	$1 \cdot 3$

$(3p + 1)(5p + 3) = 15p^2 + 14p + 3$

88. $3u^2 - 21u + 18 = 3(u^2 - 7u + 6) = 3(u - 1)(u - 6)$
89. $15h^3 + 11h^2 - 45h - 33 = h^2(15h + 11) - 3(15h + 11) = (h^2 - 3)(15h + 11)$
90. $30x^3 + 42x^2 - 5x - 7 = 6x^2(5x + 7) - (5x + 7) = (6x^2 - 1)(5x + 7)$ **91.** $12s^4t + 20s^3t - 8s^2t = 4s^2t(3s^2 + 5s - 2) = 4s^2t(3s - 1)(s + 2)$
92. $2x^3 + 7x^2 + 4x + 14 = x^2(2x + 7) + 2(2x + 7) = (x^2 + 2)(2x + 7)$ **93.** $6p^3 + 38p^2 + 40p = 2p(3p^2 + 19p + 20) = 2p(p + 5)(3p + 4)$; the dimensions are $2p$, $p + 5$, and $3p + 4$.

CHAPTER TEST *page 506*

1. $-2y^2 - 3y + 5$; quadratic trinomial
2. $-2v^3 - 6v^2 - 17v$; cubic trinomial **3.** $8x^4 - 6x^2 - 10$; fourth-degree trinomial **4.** $-3k^5 - k^2$; fifth-degree binomial **5.** $(4x^2 + 2x + 5) + (7x^2 - 5x + 2) = (4 + 7)x^2 + (2 - 5)x + 5 + 2 = 11x^2 - 3x + 7$
6. $(9a^2 - 4 - 5a) - (12a - 6a^2 + 3) = (9 + 6)a^2 + (-5 - 12)a - 4 - 3 = 15a^2 - 17a - 7$
7. $(-4m^2 + m - 10) + (3m + 12 - 7m^2) = (-4 - 7)m^2 + (1 + 3)m - 10 + 12 = -11m^2 + 4m + 2$ **8.** $(3c - 4c^2 + c^3) - (5c^2 + 8c^3 - 6c) = (1 - 8)c^3 + (-4 - 5)c^2 + (3 + 6)c = -7c^3 - 9c^2 - 9c$
9. Answers may vary. Sample: $p^6 + p^2 + 1$
10. $x^2 + 3x + 2x + 6 = x^2 + 5x + 6$
11. $8b(3b + 7 - b^2) = 8b(3b) + 8b(7) - 8b(b^2) = -8b^3 + 24b^2 + 56b$ **12.** $-t(5t^2 + t) = -t(5t^2) - t(t) = -5t^3 - t^2$ **13.** $3q(4 - q + 3q^3) = 3q(4) - 3q(q) + 3q(3q^3) = 9q^4 - 3q^2 + 12q$
14. $2c(c^5 + 4c^3) = 2c(c^5) + 2c(4c^3) = 2c^6 + 8c^4$
15. $(x + 6)(x + 1) = x^2 + 1x + 6x + 6 = x^2 + 7x + 6$
16. $(d + 4)(d - 3) = d^2 - 3d + 4d - 12 = d^2 + d - 12$
17. $(2h - 1)(h - 4) = 2h^2 - 8h - 1h + 4 = 2h^2 - 9h + 4$ **18.** $(2m + 5)(3m - 7) = 6m^2 - 14m + 15m - 35 = 6m^2 + m - 35$
19. $(p + 2)(2p^2 - 5p + 4) = 2p^3 - 5p^2 + 4p + 4p^2 - 10p + 8 = 2p^3 - p^2 - 6p + 8$ **20.** $(a - 4)(6a^2 + 10a - 3) =$

$6a^3 + 10a^2 - 3a - 24a^2 - 40a + 12 =$
$6a^3 - 14a^2 - 43a + 12$ **21.** $(3x + 5)(7x^2 - 2x + 1) =$
$21x^3 + 29x^2 - 7x + 5$ **22.** $21x^4 = 7 \cdot 3 \cdot x^4$; $18x^2 =$
$3 \cdot 3 \cdot 2 \cdot x^2$; $36x^3 = 3 \cdot 3 \cdot 2 \cdot 2 \cdot x^3$; GCF $= 3x^2$
23. GCF $= t$ **24.** $3a^{10} = 3 \cdot a^{10}$; $9a^5 = 3 \cdot 3 \cdot a^5$; $6a^{15} =$
$3 \cdot 2 \cdot a^{15}$; GCF $= 3a^5$ **25.** $9m^3 = 3 \cdot 3 \cdot m^3$; $7m^4 =$
$7 \cdot m^4$; $8m^2 = 2 \cdot 2 \cdot 2 \cdot m^2$; GCF $= m^2$ **26.** Multiply each term of the first polynomial by each term of the second polynomial. Then combine like terms. Example:
$(x + 3)(x^2 - x + 1) = x^3 - x^2 + x + 3x^2 - 3x + 3 =$
$x^3 + 2x^2 - 2x + 3$ **27.** width $= x$; length $= 3x + 5$;
area $= x(3x + 5) = 3x^2 + 5x$ [m] **28.** width $= w$;
height $= w - 2$; length $= 4w + 4$; volume $=$
$w(w - 2)(4w + 3) = w(4w^2 - 5w - 6) =$
$4w^3 - 5w^2 - 6w$; $(4w^3 - 5w^2 - 6w)$ in.^{3}
29. $\frac{1}{2}(2x)(4x - 3) = 4x^2 - 3x$
30. $3x(2x + 1) - 2x(x + 1) = 6x^2 + 3x - 2x^2 - 2x =$
$4x^2 + x$ **31.** $-7 \cdot 2 = -14$; $-7 + 2 =$
-5; $w^2 - 5w - 14 = (w - 7)(w + 2)$
32. $g^2 + 10g + 25 = g^2 + 2(g)5 + 5^2 = (g + 5)^2$
33. $9k^2 + 24k + 16 = (3k)^2 + 2(3k) + 4^2 = (3k + 4)^2$
34. $n^2 - 100 = (n + 10)(n - 10)$ **35.** $y^2 - 4y + 4 =$
$(y - 2)^2$ **36.** $4x^2 - 49 = (2x)^2 - 7^2 = (2x + 7)(2x - 7)$
37.

$4p^2$	$+ 164p$	$+ 81$
$4 \cdot 1$	$4 \cdot 81 + 1 \cdot 1 = 325$	$1 \cdot 81$
$2 \cdot 2$	$2 \cdot 1 + 2 \cdot 81 = 164$ ✓	$1 \cdot 81$

$(2p + 1)(2p + 81) = 4p^2 + 164p + 81$

38. $13c^2 - 52 = 13(c^2 - 4) = 13(c + 2)(c - 2)$
39. ■ $= 2(1)(7) = 14$ **40.** $12 = 2(3)($■$)$; ■ $= 2$
41. $2(3)(5) = 30$, so ■ $= 5^2 = 25$ **42.** ■ $= 2(2)(9) = 36$
43. $3x^2$; -4 **44.** $4n^2$; -1 **45.** $12n^3 + 15n^2 + 4n + 5 =$
$3n^2(4n + 5) + (4n + 5) = (3n^2 + 1)(4n + 5)$
46. $4x^2 - 10x + 6 = 2(2x^2 - 5x + 3) =$
$2(2x - 3)(x - 1)$ **47.** $x^3 - 5x^2 + 5x - 25 =$
$x^2(x - 5) + 5(x - 5) = (x^2 + 5)(x - 5)$
48. $6r^3 - 9r^2 - 4r + 6 = 3r^2(2r - 3) - 2(2r - 3) =$
$(3r^2 - 2)(2r - 3)$ **49.** $12y^3 + 28y^2 - 3y - 7 =$
$4y^2(3y + 7) - (3y + 7) = (4y^2 - 1)(3y + 7) =$
$(2y + 1)(2y - 1)(3y + 7)$ **50.** $3n^3 - 4n^2 - 6n + 8 =$
$n^2(3n - 4) - 2(3n - 4) = (n^2 - 2)(3n - 4)$
51. Answers may vary. Sample:
$x^2 + ax + 30 = (x + 1)(x + 30)$; $a = 31$
$(x + 2)(x + 15)$; $a = 17$
$(x + 3)(x + 10)$; $a = 13$
$(x + 5)(x + 6)$; $a = 11$

STANDARDIZED TEST PREP *page 507*

1. $20{,}000(1.05)^3 = 23{,}152.50$; the answer is C. **2.** The answer is G. **3.** The answer is B. **4.** $4{,}870(1.04)^3 = 5478$; $0.25 \cdot 23{,}152 = 5788$; the answer is F. **5a.** $1000(1.06)^{10} \approx$ 1790.85; \$1790.85 **5b.** Interest $= 1790.85 - 1000 =$ 790.85; $0.23 \cdot 790.85 = 181.90$ [\$].