Use the properties of exponents to simplify each expression. See Examples 1–3.

9. $(2^2)^5$ **10.** $(6^4)^3$ **11.** $-(4m^3n^0)^2$

12. $(2x^0y^4)^3$ **13.** $\left(\frac{r^8}{s^2}\right)^3$ **14.** $-\left(\frac{p^4}{q}\right)^2$

Match each expression in Column I with its equivalent in Column II. See Example 3.

15.

I	II
(a) 6^0	A. 0
(b) -6^0	B. 1
(c) $(-6)^0$	C. -1
(d) $-(-6)^0$	D. 6
	E. -6

16.

I	II
(a) $3p^0$	A. 0
(b) $-3p^0$	B. 1
(c) $(3p)^0$	C. -1
(d) $(-3p)^0$	D. 3
	E. -3

17. Explain why $x^2 + x^2 \neq x^4$.

18. Explain why $(x + y)^2 \neq x^2 + y^2$.

Identify each expression as a polynomial *or* not a polynomial. *For each polynomial, give the degree and identify it as a* monomial, binomial, trinomial, *or* none of these.

19. $-5x^{11}$ **20.** $9y^{12} + y^2$ **21.** $18p^5q + 6pq$

22. $2a^6 + 5a^2 + 4a$ **23.** $\sqrt{2}x^2 + \sqrt{3}x^6$ **24.** $-\sqrt{7}m^5n^2 + 2\sqrt{3}m^3n^2$

25. $\frac{1}{3}r^2s^2 - \frac{3}{5}r^4s^2 + rs^3$ **26.** $\frac{13}{10}p^7 - \frac{2}{7}p^5$ **27.** $\frac{5}{p} + \frac{2}{p^2} + \frac{5}{p^3}$

28. $-5\sqrt{z} + 2\sqrt{z^3} - 5\sqrt{z^5}$

Find each sum or difference. See Example 4.

29. $(3x^2 - 4x + 5) + (-2x^2 + 3x - 2)$

30. $(4m^3 - 3m^2 + 5) + (-3m^3 - m^2 + 5)$

31. $2(12y^2 - 8y + 6) - 4(3y^2 - 4y + 2)$

32. $3(8p^2 - 5p) - 5(3p^2 - 2p + 4)$

33. $(6m^4 - 3m^2 + m) - (2m^3 + 5m^2 + 4m) + (m^2 - m)$

34. $-(8x^3 + x - 3) + (2x^3 + x^2) - (4x^2 + 3x - 1)$

Find each product. See Examples 5 and 6.

35. $(4r - 1)(7r + 2)$ **36.** $(5m - 6)(3m + 4)$

37. $x^2\left(3x - \frac{2}{3}\right)\left(5x + \frac{1}{3}\right)$ **38.** $\left(2m - \frac{1}{4}\right)\left(3m + \frac{1}{2}\right)$

39. $4x^2(3x^3 + 2x^2 - 5x + 1)$ **40.** $2b^3(b^2 - 4b + 3)$

41. $(2z - 1)(-z^2 + 3z - 4)$ **42.** $(k + 2)(12k^3 - 3k^2 + k + 1)$

43. $(m - n + k)(m + 2n - 3k)$ **44.** $(r - 3s + t)(2r - s + t)$

Find each product. See Examples 7 and 8.

45. $(2m + 3)(2m - 3)$ **46.** $(8s - 3t)(8s + 3t)$ **47.** $(4x^2 - 5y)(4x^2 + 5y)$

48. $(2m^3 + n)(2m^3 - n)$ **49.** $(4m + 2n)^2$ **50.** $(a - 6b)^2$

51. $(5r - 3t^2)^2$ **52.** $(2z^4 - 3y)^2$

53. $[(2p - 3) + q]^2$ **54.** $[(4y - 1) + z]^2$

$^2 + 30q + 25 - p^2$
$r^2 - 18rs + s^2 - 4$
$^2 + 6ab + b^2 - 6a -$
1 **58.** $4m^2 + 28m +$
$4mn - 14n + n^2$
$+ 6y^2 + 12y + 8$
$- 9z^2 + 27z - 27$
$- 8q^3 + 24q^2 - 32q +$
2. $r^4 + 12r^3 + 54r^2 +$
$+ 81$
$- 7p^2 - p - 7$
$^2 - 5zy - 4y^2$
$m^2 - 4n^2$
$^2 + 30p + 25$
$14q^2 + 11q - 14$
$^2 - 4r + 19$
$^2 - 16$
$n^2 - 11m + 45$
$y^3 - 18y^2 + 4y$
$- 9z^3 + 12z^2 + 8z$
$^5 + 7x^4 - 5x^2 + 7$
$2r^2 - 3rs + 5s^2$
$5x^2 + 8 + \frac{2}{x^2}$
$^2 + 9x + 25 + \frac{80}{x - 3}$
$n^2 + m - 2 + \frac{6}{3m + 2}$
$^2 + 3x + 2 + \frac{-2x + 11}{3x^2 - 2}$
$- x^2 - x + 4 + \frac{-17}{3x + 3}$
$- 5 + \frac{2k + 10}{k^2 + 1}$
99 **82.** 3591 **83.** 10,404
41

55. $[(3q + 5) - p][(3q + 5) + p]$
56. $[(9r - s) + 2][(9r - s) - 2]$
57. $[(3a + b) - 1]^2$
58. $[(2m + 7) - n]^2$
59. $(y + 2)^3$
60. $(z - 3)^3$
61. $(q - 2)^4$
62. $(r + 3)^4$

Perform the indicated operations. See Examples 4–8.

63. $(p^3 - 4p^2 + p) - (3p^2 + 2p + 7)$
64. $(2z + y)(3z - 4y)$
65. $(7m + 2n)(7m - 2n)$
66. $(3p + 5)^2$
67. $-3(4q^2 - 3q + 2) + 2(-q^2 + q - 4)$
68. $2(3r^2 + 4r + 2) - 3(-r^2 + 4r - 5)$
69. $p(4p - 6) + 2(3p - 8)$
70. $m(5m - 2) + 9(5 - m)$
71. $-y(y^2 - 4) + 6y^2(2y - 3)$
72. $-z^3(9 - z) + 4z(2 + 3z)$

Perform each division. See Examples 9 and 10.

73. $\frac{-4x^7 - 14x^6 + 10x^4 - 14x^2}{-2x^2}$
74. $\frac{-8r^3s - 12r^2s^2 + 20rs^3}{4rs}$
75. $\frac{10x^8 - 16x^6 - 4x^4}{-2x^6}$
76. $\frac{3x^3 - 2x + 5}{x - 3}$
77. $\frac{6m^3 + 7m^2 - 4m + 2}{3m + 2}$
78. $\frac{6x^4 + 9x^3 + 2x^2 - 8x + 7}{3x^2 - 2}$
79. $\frac{3x^4 - 6x^2 + 9x - 5}{3x + 3}$
80. $\frac{k^4 - 4k^2 + 2k + 5}{k^2 + 1}$

Relating Concepts*

For individual or collaborative investigation
(Exercises 81–84)

The special product $(a + b)(a - b) = a^2 - b^2$ *can be used to perform some multiplication problems. For example,*

$$\begin{aligned} 51 \times 49 &= (50 + 1)(50 - 1) \\ &= 50^2 - 1^2 \\ &= 2500 - 1 \\ &= 2499. \end{aligned}$$

Similarly, the perfect square pattern gives

$$\begin{aligned} 47^2 &= (50 - 3)^2 \\ &= 50^2 - 2(50)(3) + 3^2 \\ &= 2500 - 300 + 9 \\ &= 2209. \end{aligned}$$

Use special products to evaluate each expression.

81. 99×101 **82.** 63×57 **83.** 102^2 **84.** 71^2

*Many exercise sets will contain groups of exercises under the heading Relating Concepts. These exercises are provided to illustrate how the concepts currently being studied relate to previously learned concepts. In most cases, they should be worked sequentially. We provide the answers to all such exercises, both even- and odd-numbered, in the Answer Section at the back of the book.