## EXERCISES 1.8

*In Exercises 1–4, make the given changes in the indicated examples of this section, and then solve the resulting problems.*

1. In Example 2(b), change the factor $(-st^4)^2$ to $(-st^4)^3$.
2. In Example 3(a), change the factor $2ax$ to $-2ax$.
3. In Example 4, change the factor $(x + 3)$ to $(x - 3)$.
4. In Example 5(b), change the exponent 3 to 2.

*In Exercises 5–68, perform the indicated multiplications.*

5. $(a^2)(ax)$
6. $(2xy)(x^2y^3)$
7. $-ac^2(acx^3)$
8. $-2s^2(-4cs)^2$
9. $(2ax^2)^2(-2ax)$
10. $6pq^3(3pq^2)^2$
11. $a(-a^2x)^3(-2a)$
12. $-2m^2(-3mn)(m^2n)^2$
13. $i^2(R + r)$
14. $2x(p - q)$
15. $-3s(s^2 - 5t)$
16. $-3b(2b^2 - b)$
17. $5m(m^2n + 3mn)$
18. $a^2bc(2ac - 3a^2b)$
19. $3M(-M - N + 2)$
20. $b^2x^2(x^2 - 2x + 1)$
21. $ab^2c^4(ac - bc - ab)$
22. $-4c^2(\frac{1}{4}9gc - 2c + g^2)$
23. $ax(cx^2)(x + y^3)$
24. $-2(-3st^3)(3s - 4t)$
25. $(x - 3)(x + 5)$
26. $(a + 7)(a + 1)$
27. $(x + 5)(2x - 1)$
28. $(4t_1 + t_2)(2t_1 - 3t_2)$
29. $(2a - b)(3a - 2b)$
30. $(4w^2 - 3)(3w^2 - 1)$
31. $(2s + 7t)(3s - 5t)$
32. $(5p - 2q)(p + 8q)$
33. $(x^2 - 1)(2x + 5)$
34. $(3y^2 + 2)(2y - 9)$
35. $(x^2 - 2x)(x + 4)$
36. $(2ab^2 - 5t)(-ab^2 - 6t)$
37. $(x + 1)(x^2 - 3x + 2)$
38. $(2F + 3)(F^2 - F - 5)$
39. $(4x - x^3)(2 + x - x^2)$
40. $(5a - 3c)(a^2 + ac - c^2)$
41. $2(a + 1)(a - 9)$
42. $-5(y - 3)(y + 6)$
43. $-3(3 - 2T)(3T + 2)$
44. $2n(5 - n)(6n + 5)$
45. $2L(L + 1)(L - 4)$
46. $ax(x + 4)(7 - x^2)$
47. $(2x - 5)^2$
48. $(x - 3)^2$
49. $(x_1 + 3x_2)^2$
50. $(2m + 1)^2$
51. $(xyz - 2)^2$
52. $(b - 2x^2)^2$
53. $2(x + 8)^2$
54. $3(3R + 4)^2$
55. $(2 + x)(3 - x)(x - 1)$
56. $(3x - c^2)^3$
57. $3T(T + 2)(2T - 1)$
58. $[(x - 2)^2(x + 2)]^2$
59. Let $x = 3$ and $y = 4$ to show that (a) $(x + y)^2 \neq x^2 + y^2$ and (b) $(x - y)^2 \neq x^2 - y^2$. ($\neq$ means "does not equal.")
60. Evaluate the product (98)(102) by expressing it as $(100 - 2)(100 + 2)$.
61. (W) Square an integer between 1 and 9 and subtract 1 from the result. Explain why the result is the product of the integer before and the integer after the one you chose.
62. (W) Explain how, by appropriate grouping, the product $(x - 2)(x + 3)(x + 2)(x - 3)$ is easier to find. Find the product.
63. In using aircraft radar, the expression $(2R - X)^2 - (R^2 + X^2)$ arises. Simplify this expression.
64. In calculating the temperature variation of an industrial area, the expression $(2T^3 + 3)(T^2 - T - 3)$ arises. Perform the indicated multiplication.
65. In a particular computer design containing $n$ circuit elements, $n^2$ switches are needed. Find the expression for the number of switches needed for $n + 100$ circuit elements.
66. Simplify the expression $(T^2 - 100)(T - 10)(T + 10)$, which arises when analyzing the energy radiation from an object.
67. In finding the maximum power in part of a microwave transmitter circuit, the expression $(R_1 + R_2)^2 - 2R_2(R_1 + R_2)$ is used. Multiply and simplify.
68. In determining the deflection of a certain steel beam, the expression $27x^2 - 24(x - 6)^2 - (x - 12)^3$ is used. Multiply and simplify.

## 1.9 DIVISION OF ALGEBRAIC EXPRESSIONS

To find the quotient of one monomial divided by another, we use the laws of exponents and the laws for dividing signed numbers. Again, the *exponents may be combined only if the base is the same.*

EXAMPLE 1 (a) $\dfrac{3c^7}{c^2} = 3c^{7-2} = 3c^5$ (b) $\dfrac{16x^3y^5}{4xy^2} = \dfrac{16}{4}(x^{3-1})(y^{5-2}) = 4x^2y^3$

(c) $\dfrac{-6a^2xy^2}{2axy^4} = -\left(\dfrac{6}{2}\right)\dfrac{a^{2-1}x^{1-1}}{y^{4-2}} = -\dfrac{3a}{y^2}$

In (b): divide coefficients; subtract exponents.

As shown in illustration (c), we use only positive exponents in the final result unless there are specific instructions otherwise.

## EXERCISES 1.9

*In Exercises 1–4, make the given changes in the indicated examples of this section and then perform the indicated divisions.*

1. In Example 1(c), change the denominator to $-2a^2xy^5$.
2. In Example 2(b), change the denominator to $2xy^2$.
3. In Example 5, change the dividend to $6x^2 - 7x + 2$.
4. In Example 6, change the sign of the middle term of the numerator from + to −.

*In Exercises 5–24, perform the indicated divisions.*

5. $\dfrac{8x^3y^2}{-2xy}$
6. $\dfrac{-18b^7c^3}{bc^2}$
7. $\dfrac{-16r^3t^5}{-4r^5t}$
8. $\dfrac{51mn^5}{17m^2n^2}$
9. $\dfrac{(15x^2)(4bx)(2y)}{30bxy}$
10. $\dfrac{(5sT)(8s^2T^3)}{10s^3T^2}$
11. $\dfrac{6(ax)^2}{-ax^2}$
12. $\dfrac{12a^2b}{(3ab^2)^2}$
13. $\dfrac{a^2x + 4xy}{x}$
14. $\dfrac{2m^2n - 6mn}{2m}$
15. $\dfrac{3rst - 6r^2st^2}{3rs}$
16. $\dfrac{-5a^2n - 10an^2}{5an}$
17. $\dfrac{4pq^3 + 8p^2q^2 - 16pq^5}{4pq^2}$
18. $\dfrac{a^2x_1x_2^2 + ax_1^3 - ax_1}{ax_1}$
19. $\dfrac{2\pi fL - \pi fR^2}{\pi fR}$
20. $\dfrac{2(ab)^4 - a^3b^4}{3(ab)^3}$
21. $\dfrac{3ab^2 - 6ab^3 + 9a^2b^2}{9a^2b^2}$
22. $\dfrac{2x^2y^2 + 8xy - 12x^2y^4}{2x^2y^2}$
23. $\dfrac{x^{n+2} + ax^n}{x^n}$
24. $\dfrac{3a(F + T)b^2 - (F + T)}{a(F + T)}$

*In Exercises 25–42, perform the indicated divisions. Express the answer as shown in Example 6 when applicable.*

25. $(2x^2 + 7x + 3) \div (x + 3)$
26. $(3x^2 - 11x - 4) \div (x - 4)$
27. $\dfrac{x^2 - 3x + 2}{x - 2}$
28. $\dfrac{2x^2 - 5x - 7}{x + 1}$
29. $\dfrac{x - 14x^2 + 8x^3}{2x - 3}$
30. $\dfrac{6x^2 + 6 + 7x}{2x + 1}$
31. $(4Z^2 + 23Z + 18) \div (4Z + 3)$
32. $(6x^2 - 20x + 16) \div (3x - 4)$
33. $\dfrac{x^3 + 3x^2 - 4x - 12}{x + 2}$
34. $\dfrac{3x^3 + 19x^2 + 13x - 20}{3x - 2}$
35. $\dfrac{2x^4 + 4x^3 + 2}{x^2 - 1}$
36. $\dfrac{2x^3 - 3x^2 + 8x - 2}{x^2 - x + 2}$
37. $\dfrac{x^3 + 8}{x + 2}$
38. $\dfrac{D^3 - 1}{D - 1}$
39. $\dfrac{x^2 - 2xy + y^2}{x - y}$
40. $\dfrac{3r^2 - 5rR + 2R^2}{r - 3R}$
41. $\dfrac{5E^3 + 8E^2 - 23E - 1}{5E^2 - 7E - 2}$
42. $\dfrac{3x^4 - 2ax^3 - 9a^2x^2 + 2}{3x^2 + ax - 2a^2}$

*In Exercises 43–48, perform the indicated divisions.*

43. In the optical theory dealing with lasers, the following expr sion arises: $\dfrac{8A^5 + 4A^3\mu^2E^2 - A\mu^4E^4}{8A^4}$. Perform the indica division. ($\mu$ is the Greek letter mu.)

44. In finding the total resistance of the resistors shown Fig. 1.12, the expression $\dfrac{6R_1 + 6R_2 + R_1R_2}{6R_1R_2}$ is used. Perfo the indicated division.

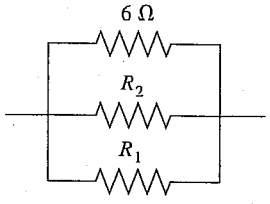


**Fig. 1.12**

45. When analyzing the potential energy associated with gravitatio forces, the expression $\dfrac{GMm[(R + r) - (R - r)]}{2rR}$ arises. Perfo the indicated division.

46. A computer model shows that the temperature change $T$ a certain freezing unit is found by using the expressi $\dfrac{3T^3 - 8T^2 + 8}{T - 2}$. Perform the indicated division.

47. In analyzing the displacement of a certain valve, the expr sion $\dfrac{s^2 - 2s - 2}{s^4 + 4}$ is used. Find the reciprocal of this expr sion and then perform the indicated division.

48. The voltage and resistance in a certain electric circuit va with time such that the current is given by the expr sion $\dfrac{2t^3 + 94t^2 - 290t + 500}{2t + 100}$. By performing the indicat division, find the expression for the current.