In Exercises 1–8, find the domain of the expression.

1. $3x^2 - 4x + 7$
2. $2x^2 + 5x - 2$
3. $4x^3 + 3, \quad x \geq 0$
4. $6x^2 - 9, \quad x > 0$
5. $\dfrac{1}{x - 2}$
6. $\dfrac{x + 1}{2x + 1}$
7. $\sqrt{x + 1}$
8. $\sqrt{6 - x}$

In Exercises 9 and 10, find the missing factor in the numerator such that the two fractions are equivalent.

9. $\dfrac{5}{2x} = \dfrac{5(\blacksquare)}{6x^2}$
10. $\dfrac{3}{4} = \dfrac{3(\blacksquare)}{4(x + 1)}$

In Exercises 11–28, write the rational expression in simplest form.

11. $\dfrac{15x^2}{10x}$
12. $\dfrac{18y^2}{60y^5}$
13. $\dfrac{3xy}{xy + x}$
14. $\dfrac{2x^2y}{xy - y}$
15. $\dfrac{4y - 8y^2}{10y - 5}$
16. $\dfrac{9x^2 + 9x}{2x + 2}$
17. $\dfrac{x - 5}{10 - 2x}$
18. $\dfrac{12 - 4x}{x - 3}$
19. $\dfrac{y^2 - 16}{y + 4}$
20. $\dfrac{x^2 - 25}{5 - x}$
21. $\dfrac{x^3 + 5x^2 + 6x}{x^2 - 4}$
22. $\dfrac{x^2 + 8x - 20}{x^2 + 11x + 10}$
23. $\dfrac{y^2 - 7y + 12}{y^2 + 3y - 18}$
24. $\dfrac{x^2 - 7x + 6}{x^2 + 11x + 10}$
25. $\dfrac{2 - x + 2x^2 - x^3}{x^2 - 4}$
26. $\dfrac{x^2 - 9}{x^3 + x^2 - 9x - 9}$
27. $\dfrac{z^3 - 8}{z^2 + 2z + 4}$
28. $\dfrac{y^3 - 2y^2 - 3y}{y^3 + 1}$

In Exercises 29 and 30, complete the table. What can you conclude?

29.

x	0	1	2	3	4	5	6
$\dfrac{x^2 - 2x - 3}{x - 3}$							
$x + 1$							

30.

x	0	1	2	3	4	5	6
$\dfrac{x - 3}{x^2 - x - 6}$							
$\dfrac{1}{x + 2}$							

31. ***Error Analysis*** Describe the error.

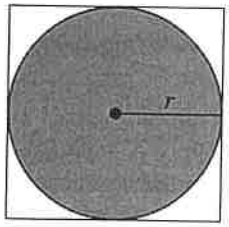
$$\cancel{\frac{5x^3}{2x^3 + 4} = \frac{5x^3}{2x^3 + 4} = \frac{5}{2 + 4} = \frac{5}{6}}$$

32. ***Error Analysis*** Describe the error.

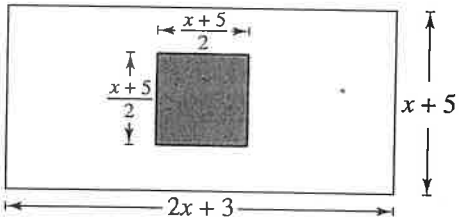
$$\cancel{\frac{x^3 + 25x}{x^2 - 2x - 15} = \frac{x(x^2 + 25)}{(x - 5)(x + 3)} = \frac{x(x + 5)(x - 5)}{(x - 5)(x + 3)} = \frac{x(x + 5)}{x + 3}}$$

Geometry **In Exercises 33 and 34, find the ratio of the area of the shaded portion of the figure to the total area of the figure.**

33.



34.



In Exercises 35–42, perform the multiplication or division and simplify.

35. $\dfrac{5}{x - 1} \cdot \dfrac{x - 1}{25(x - 2)}$
36. $\dfrac{x + 13}{x^3(3 - x)} \cdot \dfrac{x(x - 3)}{5}$
37. $\dfrac{r}{r - 1} \cdot \dfrac{r^2 - 1}{r^2}$
38. $\dfrac{4y - 16}{5y + 15} \cdot \dfrac{2y + 6}{4 - y}$
39. $\dfrac{t^2 - t - 6}{t^2 + 6t + 9} \cdot \dfrac{t + 3}{t^2 - 4}$
40. $\dfrac{x^2 + xy - 2y^2}{x^3 + x^2y} \cdot \dfrac{x}{x^2 + 3xy + 2y^2}$
41. $\dfrac{x^2 - 36}{x} \div \dfrac{x^3 - 6x^2}{x^2 + x}$
42. $\dfrac{x^2 - 14x + 49}{x^2 - 49} \div \dfrac{3x - 21}{x + 7}$

In Exercises 43–52, perform the addition or subtraction and simplify.

43. $\dfrac{5}{x-1} + \dfrac{x}{x-1}$

44. $\dfrac{2x-1}{x+3} + \dfrac{1-x}{x+3}$

45. $6 - \dfrac{5}{x+3}$

46. $\dfrac{3}{x-1} - 5$

47. $\dfrac{3}{x-2} + \dfrac{5}{2-x}$

48. $\dfrac{2x}{x-5} - \dfrac{5}{5-x}$

49. $\dfrac{1}{x^2-x-2} - \dfrac{x}{x^2-5x+6}$

50. $\dfrac{2}{x^2-x-2} + \dfrac{10}{x^2+2x-8}$

51. $-\dfrac{1}{x} + \dfrac{2}{x^2+1} + \dfrac{1}{x^3+x}$

52. $\dfrac{2}{x+1} + \dfrac{2}{x-1} + \dfrac{1}{x^2-1}$

Error Analysis **In Exercises 53 and 54, describe the error.**

53. $$\frac{x+4}{x+2} - \frac{3x-8}{x+2} = \frac{x+4-3x-8}{x+2} = \frac{-2x-4}{x+2} = \frac{-2(x+2)}{x+2} = -2$$

54. $$\frac{6-x}{x(x+2)} + \frac{x+2}{x^2} + \frac{8}{x^2(x+2)} = \frac{x(6-x)+(x+2)^2+8}{x^2(x+2)} = \frac{6x-x^2+x^2+4+8}{x^2(x+2)} = \frac{6(x+2)}{x^2(x+2)} = \frac{6}{x^2}$$

In Exercises 55–60, simplify the complex fraction.

55. $\dfrac{\left(\dfrac{x}{2}-1\right)}{(x-2)}$

56. $\dfrac{(x-4)}{\left(\dfrac{x}{4}-\dfrac{4}{x}\right)}$

57. $\dfrac{\left[\dfrac{x^2}{(x+1)^2}\right]}{\left[\dfrac{x}{(x+1)^3}\right]}$

58. $\dfrac{\left(\dfrac{x^2-1}{x}\right)}{\left[\dfrac{(x-1)^2}{x}\right]}$

59. $\dfrac{\left(\sqrt{x}-\dfrac{1}{2\sqrt{x}}\right)}{\sqrt{x}}$

60. $\dfrac{\left(\dfrac{t^2}{\sqrt{t^2+1}}-\sqrt{t^2+1}\right)}{t^2}$

In Exercises 61–66, factor the expression by removing the common factor with the smaller exponent.

61. $x^5 - 2x^{-2}$

62. $x^5 - 5x^{-3}$

63. $x^2(x^2+1)^{-5} - (x^2+1)^{-4}$

64. $2x(x-5)^{-3} - 4x^2(x-5)^{-4}$

65. $2x^2(x-1)^{1/2} - 5(x-1)^{-1/2}$

66. $4x^3(2x-1)^{3/2} - 2x(2x-1)^{-1/2}$

In Exercises 67 and 68, simplify the expression.

67. $\dfrac{3x^{1/3} - x^{-2/3}}{3x^{-2/3}}$

68. $\dfrac{-x^3(1-x^2)^{-1/2} - 2x(1-x^2)^{1/2}}{x^4}$

In Exercises 69–72, simplify the difference quotient.

69. $\dfrac{\left(\dfrac{1}{x+h}-\dfrac{1}{x}\right)}{h}$

70. $\dfrac{\left[\dfrac{1}{(x+h)^2}-\dfrac{1}{x^2}\right]}{h}$

71. $\dfrac{\left(\dfrac{1}{x+h-4}-\dfrac{1}{x-4}\right)}{h}$

72. $\dfrac{\left(\dfrac{x+h}{x+h+1}-\dfrac{x}{x+1}\right)}{h}$

In Exercises 73–76, simplify the difference quotient by rationalizing the numerator.

73. $\dfrac{\sqrt{x+2}-\sqrt{x}}{2}$

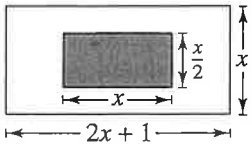
74. $\dfrac{\sqrt{z-3}-\sqrt{z}}{3}$

75. $\dfrac{\sqrt{x+h+1}-\sqrt{x+1}}{h}$

76. $\dfrac{\sqrt{x+h-2}-\sqrt{x-2}}{h}$

Probability **In Exercises 77 and 78, consider an experiment in which a marble is tossed into a box whose base is shown in the figure. The probability that the marble will come to rest in the shaded portion of the box is equal to the ratio of the shaded area to the total area of the figure. Find the probability.**

77.



78.