

EXERCISES

For more practice, see *Extra Practice*.

Practice and Problem Solving

A Practice by Example

Examples 1 and 2
(pages 392 and 393)

Let $f(x) = 3x + 5$ and $g(x) = x^2$. Perform each function operation.

- | | | |
|----------------------|-----------------------------------|-----------------------------------|
| 1. $f(x) + g(x)$ | 2. $g(x) - f(x)$ | 3. $f(x) - g(x)$ |
| 4. $f(x) \cdot g(x)$ | 5. $\frac{f(x)}{g(x)}$ | 6. $\frac{g(x)}{f(x)}$ |
| 7. $(f + g)(x)$ | 8. $(f - g)(x)$ | 9. $(g - f)(x)$ |
| 10. $(f \cdot g)(x)$ | 11. $\left(\frac{f}{g}\right)(x)$ | 12. $\left(\frac{g}{f}\right)(x)$ |

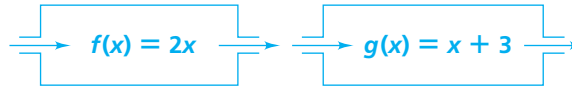
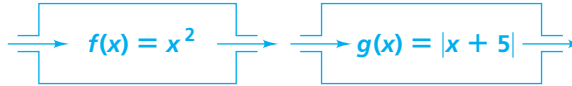
Let $f(x) = 2x^2 + x - 3$ and $g(x) = x - 1$. Perform each function operation and then find the domain.

- | | | |
|-----------------------|-------------------------|-------------------------|
| 13. $f(x) + g(x)$ | 14. $g(x) - f(x)$ | 15. $f(x) - g(x)$ |
| 16. $f(x) \cdot g(x)$ | 17. $\frac{f(x)}{g(x)}$ | 18. $\frac{g(x)}{f(x)}$ |

19. Let $f(x) = 9x$ and $g(x) = 3x$. Find $(f \cdot g)(x)$ and $\left(\frac{f}{g}\right)(x)$ and their domains.

Example 3
(page 393)

Use each diagram to find $(g \circ f)(x)$. Then evaluate $(g \circ f)(3)$ and $(g \circ f)(-2)$.

20. 
21. 

Let $g(x) = 2x$ and $h(x) = x^2 + 4$. Evaluate each expression.

- | | | |
|-----------------------|-----------------------|-----------------------|
| 22. $(h \circ g)(1)$ | 23. $(h \circ g)(-5)$ | 24. $(h \circ g)(-2)$ |
| 25. $(g \circ h)(-2)$ | 26. $(g \circ h)(0)$ | 27. $(g \circ h)(-1)$ |
| 28. $(g \circ g)(3)$ | 29. $(h \circ h)(2)$ | 30. $(h \circ h)(-4)$ |

Let $f(x) = x^2$ and $g(x) = x - 3$. Find each value or expression.

- | | | |
|---|---|------------------------|
| 31. $(g \circ f)(-2)$ | 32. $(f \circ g)(-2)$ | 33. $(g \circ f)(0)$ |
| 34. $(f \circ g)(0)$ | 35. $(g \circ f)(3.5)$ | 36. $(f \circ g)(3.5)$ |
| 37. $(f \circ g)\left(\frac{1}{2}\right)$ | 38. $(g \circ f)\left(\frac{1}{2}\right)$ | 39. $(f \circ g)(c)$ |
| 40. $(g \circ f)(c)$ | 41. $(f \circ g)(-a)$ | 42. $(g \circ f)(-a)$ |

Example 4
(page 394)

43. **Sales** A car dealer offers a 10% discount off the list price x for any car on the lot. At the same time, the manufacturer offers a \$2000 rebate for each purchase of a car.

- Write a function $f(x)$ to represent the price after the discount.
- Write a function $g(x)$ to represent the price after the \$2000 rebate.
- Suppose the list price of a car is \$18,000. Use a composite function to find the price of the car if the discount is applied before the rebate.
- Suppose the list price of a car is \$18,000. Use a composite function to find the price of the car if the rebate is applied before the discount.

44. **Economics** Suppose the function $f(x) = 0.12x$ represents the number of U.S. dollars equivalent to x Chinese yuan and the function $g(x) = 9.14x$ represents the number of Mexican pesos equivalent to x U.S. dollars.
- Write a composite function that represents the number of Mexican pesos equivalent to x Chinese yuan.
 - Find the value in Mexican pesos of an item that costs 15 Chinese yuan.

B Apply Your Skills

Let $f(x) = 2x + 5$ and $g(x) = x^2 - 3x + 2$. Perform each function operation.

45. $f(x) + g(x)$ 46. $3f(x) - 2$ 47. $g(x) - f(x)$
 48. $-2g(x) + f(x)$ 49. $f(x) - g(x) + 10$ 50. $4f(x) + 2g(x)$

Let $f(x) = 3x^2 + 2x - 8$ and $g(x) = x + 2$. Perform each function operation and then find the domain.

51. $-f(x) + 4g(x)$ 52. $f(x) - 2g(x)$ 53. $f(x) \cdot g(x)$
 54. $-3f(x) \cdot g(x)$ 55. $\frac{f(x)}{g(x)}$ 56. $\frac{5f(x)}{g(x)}$



57. **Writing** Evaluate $(g \circ f)(3)$, when $f(x) = 2x$ and $g(x) = x + 1$. Explain what you do first and why.

Let $g(x) = 3x + 2$ and $f(x) = \frac{x-2}{3}$. Find each value.

58. $f(g(1))$ 59. $g(f(-4))$ 60. $f(g(0))$ 61. $g(f(2))$



Reading Math

For help with reading and solving Exercise 62a, see p. 399.




62. **Geometry** You toss a pebble into a pool of water and watch the circular ripples radiate outward. You find that the function $r(x) = 12.5x$ describes the radius r in inches of a circle x seconds after it was formed. The function $A(x) = \pi x^2$ describes the area A of a circle with radius x .
- Find $(A \circ r)(x)$ when $x = 2$. Interpret your answer.
 - Find the area of a circle 4 seconds after it was formed.



For each pair of functions, find $f(g(x))$ and $g(f(x))$.

63. $f(x) = 3x, g(x) = x^2$ 64. $f(x) = x + 3, g(x) = x - 5$
 65. $f(x) = 3x^2 + 2, g(x) = 2x$ 66. $f(x) = \frac{x-3}{2}, g(x) = 2x - 3$
 67. $f(x) = -x - 7, g(x) = 4x$ 68. $f(x) = \frac{x+5}{2}, g(x) = x^2$

69. **Open-Ended** Write a function rule that approximates each value.
- The amount you save is a percent of what you earn. (You choose the percent.)
 - The amount you earn depends on how many hours you work. (You choose the hourly wage.)
 - Write and simplify a composite function that expresses your savings as a function of the number of hours you work. Interpret your results.

-  **70. a. Technology** Suppose $f(x) = 3x$ and $g(x) = x^2 + 3$. In the spreadsheet, values for x are in Column A. What do the formulas in B and C represent?

	A	B	C	D	E
1		=3*A1	=A1^2+3	■	■
2	0	■	■	■	■
3	5	■	■	■	■
4	10	■	■	■	■

- b.** If the formulas in columns B and C are copied down the columns, what numbers will appear?
- c.** Find $(f \circ g)(x)$.
- d.** Complete column D for $(f \circ g)(x)$.
- e.** Find $(g \circ f)(x)$.
- f.** Complete column E for $(g \circ f)(x)$.
-  **71. Profit** A craftsman makes and sells violins. The function $C(x) = 1000 + 700x$ represents his cost in dollars to produce x violins. The function $I(x) = 5995x$ represents the income in dollars from selling x violins.
- a.** Write and simplify a function $P(x) = I(x) - C(x)$.
- b.** Find $P(30)$, the profit earned when he makes and sells 30 violins.
-  **72. Writing** A salesperson earns a 3% bonus on weekly sales over \$5000.

$$g(x) = 0.03x$$

$$h(x) = x - 5000$$


- a.** Explain what each function above represents.
- b.** Which composition, $(h \circ g)(x)$ or $(g \circ h)(x)$, represents the weekly bonus? Explain.

Let $f(x) = 3x - 2$ and $g(x) = x^2 + 1$. Perform each function operation and use the properties of real numbers to justify each step in simplifying your answer.

73. $(f + g)(x)$

74. $(f - g)(x)$

75. $(f \circ g)(x)$

-  **76. Grades** Suppose your teacher offers to give the whole class a bonus if everyone passes the next math test. The teacher says she will (1) give everyone a 10-point bonus and (2) increase everyone's grade by 9% of their score.
- a.** Let x represent the original test scores. Write statements (1) and (2) as the functions $f(x)$ and $g(x)$, respectively.
- b.** Explain the meaning of $f(g(x))$. Evaluate $f(g(75))$.
- c.** Explain the meaning of $g(f(x))$. Evaluate $g(f(75))$.
- d.** Does $g(f(x)) = f(g(x))$?

 **Challenge**

Let $f(x) = x^4 + 2x^3 - 5x^2 - 10x$ and $g(x) = x^3 - 3x^2 - 5x + 15$. Perform each function operation and simplify, and then find the domain.

77. $f(x) \cdot g(x)$

78. $\frac{f(x)}{g(x)}$

79. $\frac{g(x)}{f(x)}$

Find each composition of functions. Simplify your answer.

80. Let $f(x) = \frac{1}{x}$. Find $f(f(x))$.

81. Let $f(x) = \frac{1}{x}$. Find $f(f(f(x)))$.

82. Let $f(x) = 1 - \frac{x}{2}$. Find $f(f(f(x)))$.

83. Let $f(x) = 2x - 3$. Find $\frac{f(1+h) - f(1)}{h}$, $h \neq 0$.

84. Let $f(x) = 4x - 1$. Find $\frac{f(a+h) - f(a)}{h}$, $h \neq 0$.



Standardized Test Prep

Multiple Choice

85. Let $f(x) = -4x + 1$ and $g(x) = 2x - 6$. Find $(g - f)(x)$.

A. $6x - 5$

B. $6x - 7$

C. $-6x + 5$

D. $-6x + 7$

86. If $f(x) = 2x^2$ and $g(x) = 3x$, what is $(g \circ f)(x)$?

F. $6x^2$

G. $9x^2$

H. $18x^2$

I. $8x^4$

Short Response

87. If $f(x) = 3x - 4$ and $g(x) = x + 3$, what does $(f \cdot g)(x)$ mean? What is the value of $(f \cdot g)(x)$? Simplify the answer.

Quantitative Comparison

For problems 88–91, use $f(x) = 2x^2$, $g(x) = 3x - 5$, and $h(x) = \frac{1}{x}$. Compare the boxed quantity in Column A with the boxed quantity in Column B. Choose the best answer.

A. The quantity in Column A is greater.

B. The quantity in Column B is greater.

C. The two quantities are equal.

D. The relationship cannot be determined from the information given.

Column A

Column B

88. $(f \circ g)(5)$

$(g \circ f)(5)$

89. $(h \cdot f)(x)$

$(f \cdot h)(x)$

90. $(h \circ f)(1)$

$(f \circ h)(1)$

91. $(g \cdot h)(x)$

$(h \cdot g)(x)$



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Mixed Review

Lesson 7-5 Solve. Check for extraneous solutions.

92. $\sqrt{x^2 + 3} = x + 1$ 93. $x + 8 = (x^2 + 16)^{\frac{1}{2}}$ 94. $\sqrt{x^2 + 9} = x + 1$
95. $(x^2 - 9)^{\frac{1}{2}} - x = -3$ 96. $\sqrt{x^2 + 12} - 2 = x$ 97. $(3x)^{\frac{1}{2}} = (x + 6)^{\frac{1}{2}}$

Lesson 6-8 Expand each binomial.

98. $(x + 4)^8$ 99. $(x + y)^6$ 100. $(2x - y)^4$ 101. $(2x - 3y)^7$
102. $(9 - 2x)^5$ 103. $(4x - y)^5$ 104. $(x^2 + x)^4$ 105. $(x^2 + 2y^3)^6$

Lesson 5-6 Simplify each expression.

106. $(2 - 3\sqrt{-4}) + (4 + 2\sqrt{-16})$ 107. $3\sqrt{-50} - (2 - \sqrt{-32})$
108. $(6 + \sqrt{-20}) - (-7 - \sqrt{-45})$ 109. $(5 - \sqrt{-9})(2 - \sqrt{-36})$