Name ______________________ Date ___________ Class ___________

LESSON 9-4

Practice B

Operations with Functions

Use the following functions for Exercises 1–18.

$f(x) = \frac{1}{2x}$ $\quad g(x) = x^2$ $\quad h(x) = x - 8$ $\quad k(x) = \sqrt{x}$

Find each function.

1. $(gk)(x)$ ____________
2. $(g + h)(x)$ ____________
3. $(g - h)(x)$ ____________
4. $(fg)(x)$ ____________
5. $(gh)(x)$ ____________
6. $\left(\frac{f}{g}\right)(x)$ ____________

Find each value.

7. $g(k(9))$ ____________
8. $h(g(-3))$ ____________
9. $g(h(-3))$ ____________
10. $k(h(12))$ ____________
11. $f(g(4))$ ____________
12. $f(h(1))$ ____________

Write each composite function. State the domain of each.

13. $f(g(x))$ ____________
14. $h(g(x))$ ____________
15. $h(k(x))$ ____________
16. $f(k(x))$ ____________
17. $k(g(x))$ ____________
18. $k(h(x))$ ____________

Solve.

19. A retail shoe store manager sets the price of shoes at twice his cost. The shoe store is now offering a 40% discount on all shoes.
    - **a.** Write a composite function for the price of a pair of shoes after the discount. ____________
    - **b.** If a pair of shoes cost the manager $25, what is the sale price? ____________

LESSON 9-4

Practice A

Operations with Functions

Use the following functions for Exercises 1–18.

$f(x) = x$ $\quad g(x) = x - 3$ $\quad h(x) = x^2 - 9$ $\quad k(x) = 2x$

Find each function.

1. $(gk)(x)$
$= g(x) \cdot k(x)$
$= (x - 3)(2x)$
$2x^2 - 6x$

2. $(g + k)(x)$ $\quad 3x - 3$

3. $(k - f)(x)$ $\quad x$

4. $\left(\frac{k}{f}\right)(x)$ $\quad$ 2 where $x \neq 0$

5. $(hk)(x)$ $\quad 2x^3 - 18x$

6. $\left(\frac{h}{g}\right)(x)$ $\quad x + 3$ where $x \neq 3$

7. $(h + f)(x)$ $\quad x^2 + x - 9$

8. $(g - k)(x)$ $\quad -x - 3$

9. $(g + h)(x)$ $\quad x^2 + x - 12$

Find each value.

10. $g(h(10))$
$= g(10^2 - 9) = g(91)$
88

11. $g(f(-1))$ $\quad -4$

12. $f(g(2))$ $\quad -1$

13. $g(k(3))$ $\quad 3$

14. $h(g(3))$ $\quad -9$

15. $h(k(-3))$ $\quad 27$

16. $k(f(-2))$ $\quad -4$

17. $k(g(0))$ $\quad -6$

18. $k(h(1))$ $\quad -16$

Solve.

19. The area of a square is represented by the function $A(x) = x^2$, where x is the length of a side of the square in yards.
   a. Write a composite function for the area of a square in square feet.
   Let $g(x) = 3x$, so $A(g(x)) = 9x^2$.
   b. Find the area in square feet of a square with a side length of 4 yards.
   144 ft^2

LESSON 9-4

Practice B

Operations with Functions

Use the following functions for Exercises 1–18.

$f(x) = \frac{1}{2x}$ $\quad g(x) = x^2$ $\quad h(x) = x - 8$ $\quad k(x) = \sqrt{x}$

Find each function.

1. $(gk)(x)$ $\quad x^2\sqrt{x}$

2. $(g + h)(x)$ $\quad x^2 + x - 8$

3. $(g - h)(x)$ $\quad x^2 - x + 8$

4. $(fg)(x)$ $\quad \frac{x}{2}$

5. $(gh)(x)$ $\quad x^3 - 8x^2$

6. $\left(\frac{f}{g}\right)(x)$ $\quad \frac{1}{2x^3}$

Find each value.

7. $g(k(9))$ $\quad 9$

8. $h(g(-3))$ $\quad 1$

9. $g(h(-3))$ $\quad 121$

10. $k(h(12))$ $\quad 2$

11. $f(g(4))$ $\quad \frac{1}{32}$

12. $f(h(1))$ $\quad -\frac{1}{14}$

Write each composite function. State the domain of each.

13. $f(g(x))$ $\quad f(g(x)) = \frac{1}{2x^2}$; $\{x \mid x \neq 0\}$

14. $h(g(x))$ $\quad h(g(x)) = x^2 - 8$; $\{x \mid x$ is a real number$\}$

15. $h(k(x))$ $\quad h(k(x)) = \sqrt{x} - 8$; $\{x \mid x \geq 0\}$

16. $f(k(x))$ $\quad f(k(x)) = \frac{\sqrt{x}}{2x}$; $\{x \mid x > 0\}$

17. $k(g(x))$ $\quad k(g(x)) = \pm x$; $\{x \mid x$ is a real number$\}$

18. $k(h(x))$ $\quad k(h(x)) = \sqrt{x - 8}$; $\{x \mid x \geq 8\}$

Solve.

19. A retail shoe store manager sets the price of shoes at twice his cost. The shoe store is now offering a 40% discount on all shoes.
   a. Write a composite function for the price of a pair of shoes after the discount.
   $f(g(x)) = 1.2x$
   b. If a pair of shoes cost the manager \$25, what is the sale price?
   \$30

LESSON 9-4

Practice C

Operations with Functions

Use the following functions for Exercises 1–18.

$f(x) = -\frac{1}{x}$ $\quad g(x) = x^2 - 36x$ $\quad h(x) = 6 - x$ $\quad k(x) = \sqrt{x}$

Find each function.

1. $(fg)(x)$ $\quad -x + 36$

2. $(g + h)(x)$ $\quad x^2 - 37x + 6$

3. $\left(\frac{g}{f}\right)(x)$ $\quad -x^3 + 36x^2$

Find each value.

4. $f(g(-1))$ $\quad -\frac{1}{37}$

5. $h(g(0))$ $\quad 6$

6. $h(k(121))$ $\quad -5$

7. $g(k(9))$ $\quad -99$

8. $h(g(-3))$ $\quad -111$

9. $g(h(-3))$ $\quad -243$

10. $k(h(-10))$ $\quad 4$

11. $k(f(-4))$ $\quad \frac{1}{2}$

12. $f(h(1))$ $\quad -\frac{1}{5}$

Write each composite function. State the domain of each.

13. $f(g(x))$ $\quad f(g(x)) = -\frac{1}{x^2 - 36x}$; $\{x \mid x \neq 0$ and $x \neq 36\}$

14. $k(h(x))$ $\quad k(h(x)) = \sqrt{6 - x}$; $\{x \mid x \leq 6\}$

15. $h(k(x))$ $\quad h(k(x)) = 6 - \sqrt{x}$; $\{x \mid x \geq 0\}$

16. $f(k(x))$ $\quad f(k(x)) = -\frac{1}{\sqrt{x}}$; $\{x \mid x > 0\}$

17. $k(g(x))$ $\quad k(g(x)) = \sqrt{x^2 - 36x}$; $\{x \mid x \geq 36$ or $x \leq 0\}$

18. $h(g(x))$ $\quad h(g(x)) = -x^2 + 36x + 6$; $\{x \mid x$ is a real number$\}$

Solve.

19. The cost of renting a banquet hall for an event is \$300 plus \$30 for each person attending the event. If the hall provides live music, the cost is 40% more per person.
   a. Write a function for the cost of an event that includes live music.
   $f(g(x)) = 300 + 42x$
   b. How much is the cost of an event for 125 people with live music?
   \$5550

LESSON 9-4

Reteach

Operations with Functions

Follow these steps to perform operations with functions.

Step 1 Use the notation rule for the operation.

Step 2 Substitute each function into its rule.

Step 3 Simplify by combining like terms, using the Distributive Property, and/or factoring.

Let $f(x) = x^2 - 9$ and $g(x) = x - 3$.

Notation rule

Add

$(f + g)(x) = f(x) + g(x)$
$= (x^2 - 9) + (x - 3)$
$= x^2 + x - 12$

Subtract

$(f - g)(x) = f(x) - g(x)$
$= (x^2 - 9) - (x - 3)$
$= x^2 - 9 - x + 3$
$= x^2 - x - 6$

Use the Distributive Property.

Multiply

$(fg)(x) = f(x) \cdot g(x)$
$= (x^2 - 9) \cdot (x - 3)$
$= x^3 - 3x^2 - 9x + 27$

Use FOIL.

Divide

$\frac{f}{g}(x) = \frac{f(x)}{g(x)}$
$= \frac{x^2 - 9}{x - 3}$
$= \frac{(x - 3)(x + 3)}{(x - 3)}$
$= \frac{\cancel{(x - 3)}(x + 3)}{\cancel{(x - 3)}}$
$= x + 3$ where $x \neq 3$

Factor and simplify the rational expression.

Given $f(x) = 4x^2 - 1$ and $g(x) = 2x - 1$, find each function.

1. $(f + g)(x)$
$(f + g)(x) = f(x) + g(x)$
$= 4x^2 - 1 + 2x - 1 = 4x^2 + 2x - 2$

2. $(f - g)(x)$
$(f - g)(x) = f(x) - g(x)$
$= 4x^2 - 1 - (2x - 1) = 4x^2 - 2x$

3. $(fg)(x)$
$(fg)(x) = f(x) \cdot g(x)$
$= (4x^2 - 1)(2x - 1)$
$= 8x^3 - 4x^2 - 2x + 1$

4. $\frac{f}{g}(x)$
$\frac{f}{g}(x) = \frac{f(x)}{g(x)} = \frac{4x^2 - 1}{2x - 1}$
$= \frac{(2x + 1)(2x - 1)}{2x - 1}$
$= 2x + 1$, where $x \neq \frac{1}{2}$