

2.2 Exercises

In Exercises 1–8, let $f(x) = x^3 + 5$, $g(x) = x^2 - 2$, and $h(x) = 2x + 4$. Find the rule for each function.

1. $f + g$ 2. $f - g$ 3. fg 4. gf
 5. $\frac{f}{g}$ 6. $\frac{f-g}{h}$ 7. $\frac{fg}{h}$ 8. gh

In Exercises 9–18, let $f(x) = x - 1$, $g(x) = \sqrt{x + 1}$, and $h(x) = 2x^3 - 1$. Find the rule for each function.

9. $f + g$ 10. $g - f$ 11. fg 12. gf
 13. $\frac{g}{h}$ 14. $\frac{h}{g}$ 15. $\frac{fg}{h}$ 16. $\frac{fh}{g}$
 17. $\frac{f-h}{g}$ 18. $\frac{gh}{g-f}$

In Exercises 19–24, find the functions $f + g$, $f - g$, fg , and f/g .

19. $f(x) = x^2 + 5$; $g(x) = \sqrt{x} - 2$
 20. $f(x) = \sqrt{x - 1}$; $g(x) = x^3 + 1$
 21. $f(x) = \sqrt{x + 3}$; $g(x) = \frac{1}{x - 1}$
 22. $f(x) = \frac{1}{x^2 + 1}$; $g(x) = \frac{1}{x^2 - 1}$
 23. $f(x) = \frac{x + 1}{x - 1}$; $g(x) = \frac{x + 2}{x - 2}$
 24. $f(x) = x^2 + 1$; $g(x) = \sqrt{x + 1}$

In Exercises 25–30, find the rules for the composite functions $f \circ g$ and $g \circ f$.

25. $f(x) = x^2 + x + 1$; $g(x) = x^2$
 26. $f(x) = 3x^2 + 2x + 1$; $g(x) = x + 3$
 27. $f(x) = \sqrt{x} + 1$; $g(x) = x^2 - 1$
 28. $f(x) = 2\sqrt{x} + 3$; $g(x) = x^2 + 1$

29. $f(x) = \frac{x}{x^2 + 1}$; $g(x) = \frac{1}{x}$

30. $f(x) = \sqrt{x + 1}$; $g(x) = \frac{1}{x - 1}$

In Exercises 31–34, evaluate $h(2)$, where $h = g \circ f$.

31. $f(x) = x^2 + x + 1$; $g(x) = x^2$

32. $f(x) = \sqrt[3]{x^2 - 1}$; $g(x) = 3x^3 + 1$

33. $f(x) = \frac{1}{2x + 1}$; $g(x) = \sqrt{x}$

34. $f(x) = \frac{1}{x - 1}$; $g(x) = x^2 + 1$

In Exercises 35–42, find functions f and g such that $h = g \circ f$. (Note: The answer is *not* unique.)

35. $h(x) = (2x^3 + x^2 + 1)^5$ 36. $h(x) = (3x^2 - 4)^{-3}$

37. $h(x) = \sqrt{x^2 - 1}$ 38. $h(x) = (2x - 3)^{3/2}$

39. $h(x) = \frac{1}{x^2 - 1}$ 40. $h(x) = \frac{1}{\sqrt{x^2 - 4}}$

41. $h(x) = \frac{1}{(3x^2 + 2)^{3/2}}$ 42. $h(x) = \frac{1}{\sqrt{2x + 1}} + \sqrt{2x + 1}$

In Exercises 43–46, find $f(a + h) - f(a)$ for each function. Simplify your answer.

43. $f(x) = 3x + 4$ 44. $f(x) = -\frac{1}{2}x + 3$

45. $f(x) = 4 - x^2$ 46. $f(x) = x^2 - 2x + 1$

In Exercises 47–52, find and simplify

$$\frac{f(a + h) - f(a)}{h} \quad (h \neq 0)$$

for each function.

47. $f(x) = x^2 + 1$ 48. $f(x) = 2x^2 - x + 1$