

## CHAPTER 3 Functions and Their Graphs

### 3.1 Concepts and Vocabulary (page 229)

5. independent; dependent 6. range 7.  $[0, 5]$  8.  $\neq$ ;  $f$ ;  $g$  9.  $(g - f)(x)$  10. False 11. True 12. True 13. False 14. False

### 3.1 Exercises (page 229)

15. Function; Domain: {Dad, Colleen, Kaleigh, Marissa}, Range: {January 8, March 15, September 17}  
 16. Function; Domain: {Bob, Dave, John, Chuck}; Range: {Beth, Diane, Linda, Marcia} 17. Not a function  
 18. Function; Domain: {Bob, Dave, John, Chuck}; Range: {Diane, Linda, Marcia} 19. Not a function  
 20. Function; Domain:  $\{-2, -1, 3, 4\}$ , Range:  $\{3, 5, 7, 12\}$  21. Function; Domain:  $\{1, 2, 3, 4\}$ ; Range:  $\{3\}$   
 22. Function; Domain:  $\{0, 1, 2, 3\}$ , Range:  $\{-2, 3, 7\}$  23. Not a function 24. Not a function  
 25. Function; Domain:  $\{-2, -1, 0, 1\}$ , Range:  $\{0, 1, 4\}$  26. Function; Domain:  $\{-2, -1, 0, 1\}$ , Range:  $\{3, 4, 16\}$   
 27. (a)  $-4$  (b)  $1$  (c)  $-3$  (d)  $3x^2 - 2x - 4$  (e)  $-3x^2 - 2x + 4$  (f)  $3x^2 + 8x + 1$  (g)  $12x^2 + 4x - 4$   
 (h)  $3x^2 + 6xh + 3h^2 + 2x + 2h - 4$  28. (a)  $-1$  (b)  $-2$  (c)  $-4$  (d)  $-2x^2 - x - 1$  (e)  $2x^2 - x + 1$  (f)  $-2x^2 - 3x - 2$   
 (g)  $-8x^2 + 2x - 1$  (h)  $-2x^2 - 4xh - 2h^2 + x + h - 1$   
 29. (a)  $0$  (b)  $\frac{1}{2}$  (c)  $-\frac{1}{2}$  (d)  $\frac{-x}{x^2 + 1}$  (e)  $\frac{-x}{x^2 + 1}$  (f)  $\frac{x + 1}{x^2 + 2x + 2}$  (g)  $\frac{2x}{4x^2 + 1}$  (h)  $\frac{x + h}{x^2 + 2xh + h^2 + 1}$   
 30. (a)  $-\frac{1}{4}$  (b)  $0$  (c)  $0$  (d)  $\frac{x^2 - 1}{-x + 4}$  (e)  $\frac{-x^2 + 1}{x + 4}$  (f)  $\frac{x^2 + 2x}{x + 5}$  (g)  $\frac{4x^2 - 1}{2x + 4}$  (h)  $\frac{x^2 + 2xh + h^2 - 1}{x + h + 4}$   
 31. (a)  $4$  (b)  $5$  (c)  $5$  (d)  $|x| + 4$  (e)  $-|x| - 4$  (f)  $|x + 1| + 4$  (g)  $2|x| + 4$  (h)  $|x + h| + 4$   
 32. (a)  $0$  (b)  $\sqrt{2}$  (c)  $0$  (d)  $\sqrt{x^2 - x}$  (e)  $-\sqrt{x^2 + x}$  (f)  $\sqrt{x^2 + 3x + 2}$  (g)  $\sqrt{4x^2 + 2x}$  (h)  $\sqrt{x^2 + 2xh + h^2 + x + h}$   
 33. (a)  $-\frac{1}{5}$  (b)  $-\frac{3}{2}$  (c)  $\frac{1}{8}$  (d)  $\frac{-2x + 1}{-3x - 5}$  (e)  $\frac{-2x - 1}{3x - 5}$  (f)  $\frac{2x + 3}{3x - 2}$  (g)  $\frac{4x + 1}{6x - 5}$  (h)  $\frac{2x + 2h + 1}{3x + 3h - 5}$   
 34. (a)  $\frac{3}{4}$  (b)  $\frac{8}{9}$  (c)  $0$  (d)  $1 - \frac{1}{(-x + 2)^2}$  (e)  $-1 + \frac{1}{(x + 2)^2}$  (f)  $1 - \frac{1}{(x + 3)^2}$  (g)  $1 - \frac{1}{(2x + 2)^2}$  (h)  $1 - \frac{1}{(x + h + 2)^2}$   
 35. Function 36. Function 37. Function 38. Function 39. Not a function 40. Not a function 41. Not a function  
 42. Not a function 43. Function 44. Function 45. Not a function 46. Not a function 47. All real numbers 48. All real numbers  
 49. All real numbers 50. All real numbers 51.  $\{x|x \neq -4, x \neq 4\}$  52.  $\{x|x \neq -2, x \neq 2\}$  53.  $\{x|x \neq 0\}$   
 54.  $\{x|x \neq -2, x \neq 0, x \neq 2\}$  55.  $\{x|x \geq 4\}$  56.  $\{x|x \leq 1\}$  57.  $\{x|x > 9\}$  58.  $\{x|x > 4\}$  59.  $\{x|x > 1\}$  60.  $\{x|x \leq -2\}$   
 61. (a)  $(f + g)(x) = 5x + 1$ ; All real numbers (b)  $(f - g)(x) = x + 7$ ; All real numbers  
 (c)  $(f \cdot g)(x) = 6x^2 - x - 12$ ; All real numbers (d)  $\left(\frac{f}{g}\right)(x) = \frac{3x + 4}{2x - 3}; \left\{x \mid x \neq \frac{3}{2}\right\}$   
 62. (a)  $(f + g)(x) = 5x - 1$ ; All real numbers (b)  $(f - g)(x) = -x + 3$ ; All real numbers  
 (c)  $(f \cdot g)(x) = 6x^2 - x - 2$ ; All real numbers (d)  $\left(\frac{f}{g}\right)(x) = \frac{2x + 1}{3x - 2}; \left\{x \mid x \neq \frac{2}{3}\right\}$   
 63. (a)  $(f + g)(x) = 2x^2 + x - 1$ ; All real numbers (b)  $(f - g)(x) = -2x^2 + x - 1$ ; All real numbers  
 (c)  $(f \cdot g)(x) = 2x^3 - 2x^2$ ; All real numbers (d)  $\left(\frac{f}{g}\right)(x) = \frac{x - 1}{2x^2}; \{x|x \neq 0\}$

64. (a)  $(f + g)(x) = 4x^3 + 2x^2 + 4$ ; All real numbers (b)  $(f - g)(x) = -4x^3 + 2x^2 + 2$ ; All real numbers  
 (c)  $(f \cdot g)(x) = 8x^5 + 12x^3 + 2x^2 + 3$ ; All real numbers (d)  $\left(\frac{f}{g}\right)(x) = \frac{2x^2 + 3}{4x^3 + 1}$ ;  $\left\{x \mid x \neq -\sqrt[3]{16}\right\}$
65. (a)  $(f + g)(x) = \sqrt{x} + 3x - 5$ ;  $\{x \mid x \geq 0\}$  (b)  $(f - g)(x) = \sqrt{x} - 3x + 5$ ;  $\{x \mid x \geq 0\}$   
 (c)  $(f \cdot g)(x) = 3x\sqrt{x} - 5\sqrt{x}$ ;  $\{x \mid x \geq 0\}$  (d)  $\left(\frac{f}{g}\right)(x) = \frac{\sqrt{x}}{3x - 5}$ ;  $\left\{x \mid x \geq 0, x \neq \frac{5}{3}\right\}$
66. (a)  $(f + g)(x) = |x| + x$ ; All real numbers (b)  $(f - g)(x) = |x| - x$ ; All real numbers  
 (c)  $(f \cdot g)(x) = x|x|$ ; All real numbers (d)  $\left(\frac{f}{g}\right)(x) = \frac{|x|}{x}$ ;  $\{x \mid x \neq 0\}$
67. (a)  $(f + g)(x) = 1 + \frac{2}{x}$ ;  $\{x \mid x \neq 0\}$  (b)  $(f - g)(x) = 1$ ;  $\{x \mid x \neq 0\}$  (c)  $(f \cdot g)(x) = \frac{1}{x} + \frac{1}{x^2}$ ;  $\{x \mid x \neq 0\}$   
 (d)  $\left(\frac{f}{g}\right)(x) = x + 1$ ;  $\{x \mid x \neq 0\}$  68. (a)  $(f + g)(x) = \sqrt{x - 2} + \sqrt{4 - x}$ ;  $\{x \mid 2 \leq x \leq 4\}$   
 (b)  $(f - g)(x) = \sqrt{x - 2} - \sqrt{4 - x}$ ;  $\{x \mid 2 \leq x \leq 4\}$  (c)  $(f \cdot g)(x) = \sqrt{-x^2 + 6x - 8}$ ;  $\{x \mid 2 \leq x \leq 4\}$   
 (d)  $\left(\frac{f}{g}\right)(x) = \sqrt{\frac{x - 2}{4 - x}}$ ;  $\{x \mid 2 \leq x < 4\}$  69. (a)  $(f + g)(x) = \frac{6x + 3}{3x - 2}$ ;  $\left\{x \mid x \neq \frac{2}{3}\right\}$  (b)  $(f - g)(x) = \frac{-2x + 3}{3x - 2}$ ;  $\left\{x \mid x \neq \frac{2}{3}\right\}$   
 (c)  $(f \cdot g)(x) = \frac{8x^2 + 12x}{(3x - 2)^2}$ ;  $\left\{x \mid x \neq \frac{2}{3}\right\}$  (d)  $\left(\frac{f}{g}\right)(x) = \frac{2x + 3}{4x}$ ;  $\left\{x \mid x \neq 0, x \neq \frac{2}{3}\right\}$  70. (a)  $(f + g)(x) = \sqrt{x + 1} + \frac{2}{x}$ ;  $\{x \mid x \geq -1, x \neq 0\}$   
 (b)  $(f - g)(x) = \sqrt{x + 1} - \frac{2}{x}$ ;  $\{x \mid x \geq -1, x \neq 0\}$  (c)  $(f \cdot g)(x) = \frac{2}{x}\sqrt{x + 1}$ ;  $\{x \mid x \geq -1, x \neq 0\}$   
 (d)  $\left(\frac{f}{g}\right)(x) = \frac{x\sqrt{x + 1}}{2}$ ;  $\{x \mid x \geq -1, x \neq 0\}$  71.  $g(x) = 5 - \frac{7}{2}x$  72.  $g(x) = \frac{x - 1}{x + 1}$  73. 4 74. -3 75.  $2x + h - 1$
76.  $2x + h + 5$  77.  $3x^2 + 3xh + h^2$  78.  $\frac{-1}{(x + h + 3)(x + 3)}$  79.  $A = -\frac{7}{2}$  80.  $B = 5$  81.  $A = -4$  82.  $B = -1$
83.  $A = 8$ ; undefined at  $x = 3$  84.  $A = 1, B = 2$  85.  $A(x) = \frac{1}{2}x^2$  86.  $A(x) = \frac{1}{2}x^2$  87.  $G(x) = 10x$  88.  $G(x) = 100 + 10x$
89. (a) 15.1 m, 14.07 m, 12.94 m, 11.72 m (b) 1.01 sec, 1.43 sec, 1.75 sec (c) 2.02 sec 90. (a) 7 m, 4.27 m, 1.28 m  
 (b) 0.62 sec, 0.88 sec, 1.07 sec (c) 1.24 sec 91. (a) \$222 (b) \$225 (c) \$220 (d) \$230 92. (a) 1.26 ft<sup>2</sup> (b) 1.73 ft<sup>2</sup> (c) 1.99 ft<sup>2</sup>
93.  $R(x) = \frac{L(x)}{P(x)}$  94.  $T(x) = V(x) + P(x)$  95.  $H(x) = P(x) \cdot I(x)$  96.  $N(x) = I(x) - T(x)$  97. Only  $h(x) = 2x$
98. No;  $f$  has a domain of all real numbers, while  $g$  has a domain of  $\{x \mid x \neq -1\}$ .