Math 121 – Section 2.1 Solutions

19. The relation $\{(2,6),(-3,6),(4,9),(2,10)\}$ does **not** represent a function since the input 2 gives two different outputs $6, 10$.

27. $y = x^2$ defines y as a function of x

29. $y = \dfrac{1}{x}$ defines y as a function of x

30. $y = |x|$ defines y as a function of x

35. $y = 2x^2 - 3x + 4$ defines y as a function of x

47. The domain of $f(x) = -5x + 4$ is all real numbers.

49. The domain of $f(x) = \dfrac{x}{x^2+1}$ is $\boxed{\text{all real numbers}}$. Note that there are no real roots of the denominator.

51. The domain of $f(x) = \dfrac{x}{x^2-16}$ is $\boxed{\text{all real numbers except } x = \pm 4}$. Using interval notation, the domain is $(-\infty,-4)\cup(-4,4)\cup(4,\infty)$.

55. For the function $h(x) = \sqrt{3x-12}$ we need:

$$\begin{aligned} 3x - 12 &\geq 0 \\ 3x &\geq 12 \\ x &\geq 4 \end{aligned}$$

The domain is $\boxed{x \geq 4}$. Using interval notation, the domain is $[4,\infty)$.

61. For the functions $f(x) = 3x + 4$ and $g(x) = 2x - 3$ we have:

   (a) $(f+g)(x) = (3x+4)+(2x-3) = 5x+1$

   (b) $(f-g)(x) = (3x+4)-(2x-3) = x+7$

   (c) $(fg)(x) = (3x+4)(2x-3) = 6x^2 - x - 12$

   (d) $\left(\dfrac{f}{g}\right)(x) = \dfrac{3x+4}{2x-3}$

   (e) $(f+g)(3) = 5(3)+1 = 16$

   (f) $(f-g)(4) = 4+7 = 11$

   (g) $(fg)(2) = 6(2)^2 - 2 - 12 = 10$

   (h) $\left(\dfrac{f}{g}\right)(1) = \dfrac{3(1)+4}{2(1)-3} = -7$

The domains of (a)-(c) are all real numbers. The domain of (d) is all real numbers except $x = \frac{3}{2}$.

65. For the functions $f(x) = \sqrt{x}$ and $g(x) = 3x - 5$ we have:

   (a) $(f+g)(x) = (\sqrt{x}) + (3x-5) = \sqrt{x} + 3x - 5$

   (b) $(f-g)(x) = (\sqrt{x}) - (3x-5) = \sqrt{x} - 3x + 5$

   (c) $(fg)(x) = \sqrt{x}(3x-5)$

   (d) $\left(\frac{f}{g}\right)(x) = \frac{\sqrt{x}}{3x-5}$

   (e) $(f+g)(3) = \sqrt{3} + 3(3) - 5 = \sqrt{3} + 4$

   (f) $(f-g)(4) = \sqrt{4} - 3(4) + 5 = -5$

   (g) $(fg)(2) = \sqrt{2}(3(2)-5) = \sqrt{2}$

   (h) $\left(\frac{f}{g}\right)(1) = \frac{\sqrt{1}}{3(1)-5} = -\frac{1}{2}$

   The domains of (a)-(c) are $x \geq 0$. Using interval notation, the domains are $[0, \infty)$. The domain of (d) is $x \geq 0$ but $x \neq \frac{5}{3}$. Using interval notation, the domain is $\left[0, \frac{5}{3}\right) \cup \left(\frac{5}{3}, \infty\right)$.

73. The difference quotient for $f(x) = 4x + 3$ is:

$$\begin{aligned} \frac{f(x+h) - f(x)}{h} &= \frac{4(x+h) + 3 - (4x+3)}{h} \\ &= \frac{4x + 4h + 3 - 4x - 3}{h} \\ &= \frac{4h}{h} \\ &= \boxed{4} \end{aligned}$$

75. The difference quotient for $f(x) = x^2 - x + 4$ is:

$$\begin{aligned} \frac{f(x+h) - f(x)}{h} &= \frac{(x+h)^2 - (x+h) + 4 - (x^2 - x + 4)}{h} \\ &= \frac{x^2 + 2xh + h^2 - x - h + 4 - x^2 + x - 4}{h} \\ &= \frac{2xh - h + h^2}{h} \\ &= \boxed{2x - 1 + h} \end{aligned}$$