

## Sullivan &amp; Sullivan PreCalculus

## 2.1 - Functions

In Problems 39–46, find the following for each function:

(a)  $f(0)$       (b)  $f(1)$       (c)  $f(-1)$       (d)  $f(-x)$       (e)  $-f(x)$       (f)  $f(x+1)$       (g)  $f(2x)$       (h)  $f(x+h)$

✓ 39.  $f(x) = 3x^2 + 2x - 4$

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

41.  $f(x) = \frac{x}{x^2 + 1}$

42.  $f(x) = \frac{x^2 - 1}{x + 4}$

43.  $f(x) = |x| + 4$

44.  $f(x) = \sqrt{x^2 + x}$

45.  $f(x) = \frac{2x + 1}{3x - 5}$

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

In Problems 47–60, find the domain of each function.

47.  $f(x) = -5x + 4$

48.  $f(x) = x^2 + 2$

49.  $f(x) = \frac{x}{x^2 + 1}$

50.  $f(x) = \frac{x^2}{x^2 + 1}$

51.  $g(x) = \frac{x}{x^2 - 16}$

52.  $h(x) = \frac{2x}{x^2 - 4}$

53.  $F(x) = \frac{x - 2}{x^3 + x}$

54.  $G(x) = \frac{x + 4}{x^3 - 4x}$

55.  $h(x) = \sqrt{3x - 12}$

56.  $G(x) = \sqrt{1 - x}$

57.  $f(x) = \frac{4}{\sqrt{x - 9}}$

58.  $f(x) = \frac{x}{\sqrt{x - 4}}$

59.  $p(x) = \sqrt{\frac{2}{x - 1}}$

60.  $q(x) = \sqrt{-x - 2}$

In Problems 61–70, for the given functions  $f$  and  $g$ , find the following. For parts (a)–(d), also find the domain.

(a)  $(f + g)(x)$       (b)  $(f - g)(x)$       (c)  $(f \cdot g)(x)$       (d)  $\left(\frac{f}{g}\right)(x)$

(e)  $(f + g)(3)$       (f)  $(f - g)(4)$       (g)  $(f \cdot g)(2)$       (h)  $\left(\frac{f}{g}\right)(1)$

✓ 61.  $f(x) = 3x + 4$ ;  $g(x) = 2x - 3$

62.  $f(x) = 2x + 1$ ;  $g(x) = 3x - 2$

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

64.  $f(x) = 2x^2 + 3$ ;  $g(x) = 4x^3 + 1$

65.  $f(x) = \sqrt{x}$ ;  $g(x) = 3x - 5$

66.  $f(x) = |x|$ ;  $g(x) = x$

67.  $f(x) = 1 + \frac{1}{x}$ ;  $g(x) = \frac{1}{x}$

68.  $f(x) = \sqrt{x - 1}$ ;  $g(x) = \sqrt{4 - x}$

69.  $f(x) = \frac{2x + 3}{3x - 2}$ ;  $g(x) = \frac{4x}{3x - 2}$

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

71. Given  $f(x) = 3x + 1$  and  $(f + g)(x) = 6 - \frac{1}{2}x$ , find the function  $g$

72. Given  $f(x) = \frac{1}{x}$  and  $\left(\frac{f}{g}\right)(x) = \frac{x + 1}{x^2 - x}$ , find the function  $g$ .

⚡ In Problems 73–80, find the difference quotient of  $f$ ; that is, find  $\frac{f(x+h) - f(x)}{h}$ ,  $h \neq 0$ , for each function. Be sure to simplify.

73.  $f(x) = 4x + 3$       74.  $f(x) = -3x + 1$       75.  $f(x) = x^2 - x + 4$       76.  $f(x) = x^2 + 5x - 1$   
 77.  $f(x) = 3x^2 - 2x + 6$       78.  $f(x) = 4x^2 + 5x - 7$       79.  $f(x) = x^3 - 2$       80.  $f(x) = \frac{1}{x+3}$

### Applications and Extensions

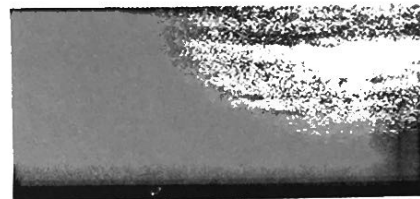
81. If  $f(x) = 2x^3 + Ax^2 + 4x - 5$  and  $f(2) = 5$ , what is the value of  $A$ ?  
 82. If  $f(x) = 3x^2 - Bx + 4$  and  $f(-1) = 12$ , what is the value of  $B$ ?  
 83. If  $f(x) = \frac{3x+8}{2x-A}$  and  $f(0) = 2$ , what is the value of  $A$ ?  
 84. If  $f(x) = \frac{2x-B}{3x+4}$  and  $f(2) = \frac{1}{2}$ , what is the value of  $B$ ?  
 85. If  $f(x) = \frac{2x-A}{x-3}$  and  $f(4) = 0$ , what is the value of  $A$ ?  
 Where is  $f$  not defined?  
 86. If  $f(x) = \frac{x-B}{x-A}$ ,  $f(2) = 0$  and  $f(1)$  is undefined, what are the values of  $A$  and  $B$ ?

- (a) What is the height of the rock when  $x = 1$  second?  $x = 1.1$  seconds?  $x = 1.2$  seconds?  $x = 1.3$  seconds?  
 (b) When is the height of the rock 15 meters? When is it 10 meters? When is it 5 meters?  
 (c) When does the rock strike the ground?

94. **Effect of Gravity on Jupiter** If a rock falls from a height of 20 meters on the planet Jupiter, its height  $H$  (in meters) after  $x$  seconds is approximately

$$H(x) = 20 - 13x^2$$

- (a) What is the height of the rock when  $x = 1$  second?  $x = 1.1$  seconds?  $x = 1.2$  seconds?  
 (b) When is the height of the rock 15 meters? When is it 10 meters? When is it 5 meters?  
 (c) When does the rock strike the ground?



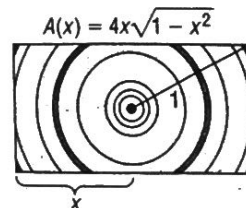
95. **Cost of Trans-Atlantic Travel** A Boeing 747 crosses the Atlantic Ocean (3000 miles) with an airspeed of 500 miles per hour. The cost  $C$  (in dollars) per passenger is given by

$$C(x) = 100 + \frac{x}{10} + \frac{36,000}{x}$$

where  $x$  is the ground speed (airspeed  $\pm$  wind).

- (a) What is the cost per passenger for quiescent (no wind) conditions?  
 (b) What is the cost per passenger with a head wind of 50 miles per hour?  
 (c) What is the cost per passenger with a tail wind of 100 miles per hour?  
 (d) What is the cost per passenger with a head wind of 100 miles per hour?

96. **Cross-sectional Area** The cross-sectional area of a beam cut from a log with radius 1 foot is given by the function  $A(x) = 4x\sqrt{1-x^2}$ , where  $x$  represents the length, in feet, of half the base of the beam. See the figure. Determine the cross-sectional area of the beam if the length of half the base of the beam is as follows:



- (a) One-third of a foot  
 (b) One-half of a foot  
 (c) Two-thirds of a foot

87. **Geometry** Express the area  $A$  of a rectangle as a function of the length  $x$  if the length of the rectangle is twice its width.  
 88. **Geometry** Express the area  $A$  of an isosceles right triangle as a function of the length  $x$  of one of the two equal sides.  
 89. **Constructing Functions** Express the gross salary  $G$  of a person who earns \$10 per hour as a function of the number  $x$  of hours worked.  
 90. **Constructing Functions** Tiffany, a commissioned salesperson, earns \$100 base pay plus \$10 per item sold. Express her gross salary  $G$  as a function of the number  $x$  of items sold.

91. **Population as a Function of Age** The function

$$P(a) = 0.015a^2 - 4.962a + 290.580$$

represents the population  $P$  (in millions) of Americans in 2005 that are  $a$  years of age or older.

**Source:** U.S. Census Bureau

- (a) Identify the dependent and independent variable.  
 (b) Evaluate  $P(20)$ . Provide a verbal explanation of the meaning of  $P(20)$ .  
 (c) Evaluate  $P(0)$ . Provide a verbal explanation of the meaning of  $P(0)$ .

92. **Number of Rooms** The function

$$N(r) = -1.44r^2 + 14.52r - 14.96$$

represents the number  $N$  of housing units (in millions) in 2005 that have  $r$  rooms, where  $r$  is an integer and  $2 \leq r \leq 9$ .

**Source:** U.S. Census Bureau

- (a) Identify the dependent and independent variable.  
 (b) Evaluate  $N(3)$ . Provide a verbal explanation of the meaning of  $N(3)$ .

93. **Effect of Gravity on Earth** If a rock falls from a height of 20 meters on Earth, the height  $H$  (in meters) after  $x$  seconds is approximately

$$H(x) = 20 - 4.9x^2$$