

2.1 Functions and Their Graphs

MULTIPLE CHOICE

1. Let f be the function defined by $f(x) = 4x + 8$.

Find $f(1)$, $f(-1)$, $f(a)$, $f(-a)$, and $f(a+1)$.

- a. $f(1) = 12$, $f(-1) = 4$, $f(a) = a + 8$, $f(-a) = -a + 8$, $f(a+1) = 4a + -4$
- b. $f(1) = 11$, $f(-1) = 5$, $f(a) = 4a + 8$, $f(-a) = -4a + 8$
- c. $f(1) = 10$, $f(-1) = 6$, $f(a) = 12$, $f(-a) = 4$, $f(a+1) = 4a + 12$
- d. $f(1) = 12$, $f(-1) = 4$, $f(a) = 4a + 8$, $f(-a) = 4$, $f(a+1) = 4a + 8$
- e. $f(1) = 12$, $f(-1) = 4$, $f(a) = 4a + 8$, $f(-a) = -4a + 8$, $f(a+1) = 4a + 12$

ANS: E

PTS: 1

2. Let f be the function defined by $f(x) = 3x + 9$.

Find $f(a+h)$, $f(-a)$, $f(a^2)$, $f(a-4h)$, and $f(4a-h)$.

- a. $f(a+h) = 3a + 9$,
 $f(-a) = -3a + 9$,
 $f(a^2) = 3a^2 + 9$,
 $f(a-4h) = 3a + 9$,
 $f(4a-h) = 12a + 9$
- b. $f(a+h) = 3a + 3h + 9$,
 $f(-a) = -3a + 9$,
 $f(a^2) = 3a^2 + 9$,
 $f(a-4h) = 3a - 12h + 9$,
 $f(4a-h) = 12a - 3h + 9$
- c. $f(a+h) = 3a + 3h + 9$,
 $f(-a) = -3a + 9$,
 $f(a^2) = 3a^2 + 9$,
 $f(a-4h) = 3a - 12h$,
 $f(4a-h) = 12a - 3h$.
- d. $f(a+h) = 3a + 3h$,
 $f(-a) = -3a$,
 $f(a^2) = 3a^2$,
 $f(a-4h) = 3a - 12h$,
 $f(4a-h) = 12a - 3h$
- e. $f(a+h) = 3a + 3h + 9$,
 $f(-a) = -3a$,
 $f(a^2) = 3a^2$,
 $f(a-4h) = 3a - 12h + 9$,
 $f(4a-h) = 12a - 3h + 9$.

ANS: B

PTS: 1

3. Let f be the function defined by $f(t) = \frac{7t^2}{\sqrt{t-1}}$.

Find $f(2)$, $f(a)$, $f(x+1)$, and $f(x-1)$.

- a. $f(2) = 2, f(a) = \frac{7a^2}{\sqrt{a-1}}, f(x+1) = \frac{14x^2 + 28x + 14}{\sqrt{x}}, f(x-1) = \frac{7x^2 - 7x + 1}{\sqrt{x-2}}$
- b. $f(2) = 7, f(a) = \frac{7a^3}{\sqrt{a-2}}, f(x+1) = \frac{7x^2 + 7x + 7}{\sqrt{x}}, f(x-1) = \frac{7x^2 - 7x + 7}{\sqrt{x-2}}$
- c. $f(2) = 28, f(a) = \frac{7a^2}{\sqrt{a-1}}, f(x+1) = \frac{7x^2 + 14x + 7}{\sqrt{x}}, f(x-1) = \frac{7x^2 - 14x + 7}{\sqrt{x-2}}$
- d. $f(2) = 14, f(a) = \frac{7a^2}{\sqrt{a-1}}, f(x+1) = \frac{7x^2 + 14x + 7}{\sqrt{x}}, f(x-1) = \frac{7x^2 - 7x + 7}{\sqrt{x-1}}$
- e. $f(2) = 4, f(a) = \frac{7a}{\sqrt{a-1}}, f(x+1) = \frac{7x^2 + 7x + 1}{\sqrt{x}}, f(x-1) = \frac{7x^2 - 7x + 1}{\sqrt{x-1}}$

ANS: C

PTS: 1

4. Let f be the function defined by

$$f(x) = \begin{cases} 4 + \sqrt{25-x} & \text{if } x \leq 25 \\ \frac{25}{25-x} & \text{if } x > 25 \end{cases}$$

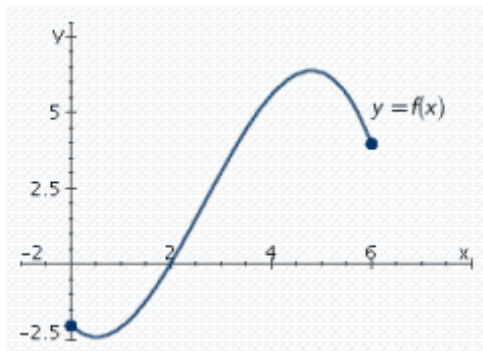
Find $f(0)$, $f(25)$, and $f(50)$.

- a. $f(0) = 29, f(25) = 4, f(50) = -1$
- b. $f(0) = 9, f(25) = \infty, f(50) = -25$
- c. $f(0) = 9, f(25) = 4, f(50) = -1$
- d. $f(0) = 4, f(25) = \infty, f(50) = -1$
- e. $f(0) = 29, f(25) = 4, f(50) = -25$

ANS: C

PTS: 1

5. Refer to the graph of the function f in the following figure.



Find the value of x for which (i) $f(x) = 3$ and (ii) $f(x) = 0$.

- a. $f(3) = 5, f(0) = -2$
- b. $f(3) = 3, f(2) = 0$
- c. $f(3) = 3, f(1) = 0$

- d. $f(4) = 3, f(3) = 0$
- e. $f(4) = 3, f(2) = 0$

ANS: B PTS: 1

6. Determine whether the point $(-6, -12)$ lies on the graph of the function

$$f(t) = \frac{|t - 5|}{t + 5}$$

- a. Yes, the point lies on the graph.
- b. No, the point does not lie on the graph.

ANS: B PTS: 1

7. Find the domain of the function.

$$f(x) = \sqrt{x^2 + 1}$$

- a. $[-1, 1]$
- b. $(-1, 1)$
- c. $[-1, \infty)$
- d. $(-\infty, \infty)$
- e. $(-\infty, 1]$

ANS: D PTS: 1

8. Find the domain of the function.

$$f(x) = \frac{x}{x^2 - 36}$$

- a. $(-6, 6)$
- b. $(-\infty, 6) \cup (6, \infty)$
- c. $(-\infty, -6) \cup (-6, 6) \cup (6, \infty)$
- d. $(-\infty, \infty)$
- e. $[-6, 6]$

ANS: C PTS: 1

9. Find the domain of the function.

$$f(x) = x^2 - x - 19$$

- a. $(-19, 19)$
- b. $[-19, 19]$
- c. $(-\infty, -19) \cup (-19, 19) \cup (19, \infty)$
- d. $(-\infty, 19) \cup (19, \infty)$
- e. $(-\infty, \infty)$

ANS: E PTS: 1

10. Find the range of the function.

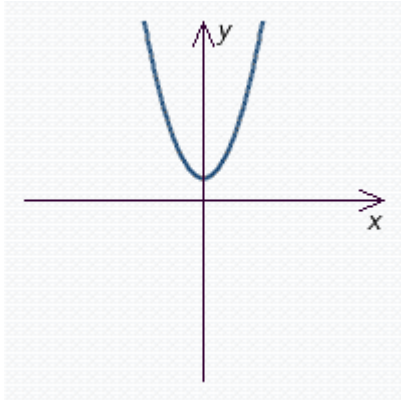
$$f(x) = 5x^2 + 2$$

- a. $(2, \infty)$
- b. $(-2, 2)$
- c. $[-2, 2]$
- d. (∞, ∞)
- e. $[2, \infty)$

ANS: E

PTS: 1

11. Use the vertical-line test to determine whether the graph represents y as a function of x .



- a. No, the graph does not represent y as a function of x .
- b. Yes, the graph represents y as a function of x .

ANS: B

PTS: 1

12. The circumference of a circle is given by $C(r) = 2\pi r$, where r is the radius of the circle. What is the circumference of a circle with a 5-in. radius?

- a. 10π
- b. 5π
- c. 10
- d. 2π
- e. 20π

ANS: A

PTS: 1

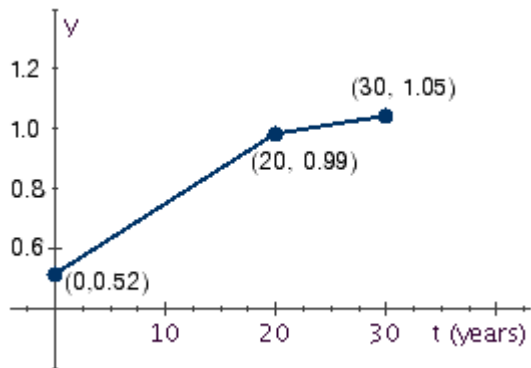
13. The volume of a spherical cancerous tumor is given by the function $V(r) = \frac{4}{3}\pi r^3$, where r is the radius of the tumor in centimeters. By what factor is the volume of the tumor increased if its radius is quintuple?

- a. 25
- b. 625
- c. 125
- d. 5
- e. 78,125

ANS: C

PTS: 1

14. The following graph shows the ratio of bachelor's degrees earned by women to men from 1960 through 1990. How fast was the ratio changing in the period from 1960 to 1980? From 1980 to 1990?



- | | |
|---|--|
| a. 0.47/yr from 1960 through 1980
0.06/yr from 1980 through 1990 | d. 0.047/yr from 1960 through 1980
0.012/yr from 1980 through 1990 |
| b. 0.235/yr from 1960 through 1980
0.06/yr from 1980 through 1990 | e. 0.0235/yr from 1960 through 1980
0.006/yr from 1980 through 1990 |
| c. 0.047/yr from 1960 through 1980
0.006/yr from 1980 through 1990 | |

ANS: E PTS: 1

15. In a certain state, the sales tax T on the amount of taxable goods is 1% of the value of the goods purchased (x), where both T and x are measured in dollars. Express T as a function of x .

- $T(x) = 0.01x$
- $T(x) = \frac{x}{1}$
- $T(x) = 1x$
- $T(x) = \frac{x}{0.01}$
- $T(x) = \frac{0.01}{x}$

ANS: A PTS: 1

16. Ace Truck leases its 10-ft box truck at \$25/day and \$0.45/mi, whereas Acme Truck leases a similar truck at \$20/day and \$0.55/mi. Find the daily cost of leasing from each company as a function of x number of miles driven.

- $25 + 0.45x, 20 + 0.55x$
- $25 + 20x, 0.45 + 0.55x$
- $25 + 0.55x, 20 + 0.45x$
- $0.45 + 25x, 0.55 + 20x$
- $20 + 25x, 0.55 + 0.45x$

ANS: A PTS: 1

17. Determine whether the statement is true or false.

If f is a function, then $f(a + b) = f(a) + f(b)$.

- a. True
- b. False

ANS: B PTS: 1

NUMERIC RESPONSE

1. The volume of a spherical cancerous tumor is given by the function $V(r) = \frac{4}{3} \pi r^3$, where r is the radius of the tumor in centimeters. By what factor is the volume of the tumor increased if its radius is decuple?

ANS: 1,000

PTS: 1

SHORT ANSWER

1. Let f be the function defined by $f(x) = 8x + 9$. Find $f(5)$, $f(-5)$, $f(a)$, $f(-a)$, and $f(a + 5)$.

ANS:

$$f(5) = 49, f(-5) = -31, f(a) = 8a + 9, f(-a) = -8a + 9, f(a + 5) = 8a + 49$$

PTS: 1

2. Let f be the function defined by $f(x) = 7x + 8$. Find $f(a + h)$, $f(-a)$, $f(a^2)$, $f(a - 3h)$, and $f(3a - h)$.

ANS:

$$f(a + h) = 7a + 7h + 8, f(-a) = -7a + 8, f(a^2) = 7a^2 + 8, f(a - 3h) = 7a - 21h + 8, f(3a - h) = 21a - 7h + 8$$

PTS: 1

3. Let f be the function defined by $f(t) = \frac{3t^2}{\sqrt{t-3}}$. Find $f(4)$, $f(a)$, $f(x + 3)$, and $f(x - 3)$.

$$f(4) = \underline{\hspace{2cm}}$$

$$f(a) = \underline{\hspace{2cm}}$$

$$f(x + 3) = \underline{\hspace{2cm}}$$

$$f(x - 3) = \underline{\hspace{2cm}}$$

ANS:

$$48, 3\frac{a^2}{\sqrt{a-3}}, 3\frac{x^2+6x+9}{\sqrt{x}}, 3\frac{x^2-6x+9}{\sqrt{x-6}}$$

PTS: 1

4. Let f be the function defined by

$$f(x) = \begin{cases} 1 + \sqrt{4-x} & \text{if } x \leq 4 \\ \frac{4}{4-x} & \text{if } x > 4 \end{cases}$$

Find $f(0)$, $f(4)$, and $f(8)$.

$$f(0) = \underline{\hspace{2cm}}$$

$$f(4) = \underline{\hspace{2cm}}$$

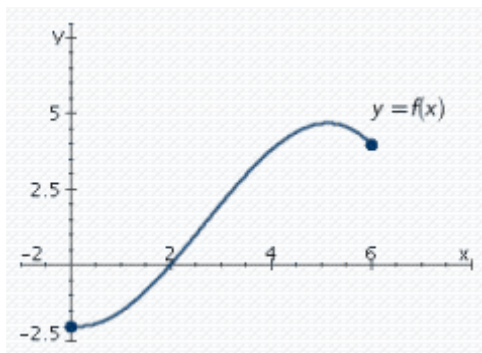
$$f(8) = \underline{\hspace{2cm}}$$

ANS:

3; 1; -1

PTS: 1

5. Refer to the graph of the function f in the following figure.



Find the value of x for which $f(x) = 2$ and $f(x) = 0$.

ANS:

3, 2

PTS: 1

6. Find the domain of the function $f(x) = \sqrt{x^2 + 15}$.

ANS:

$(-\infty, \infty)$

PTS: 1

7. Find the domain of the function $f(x) = \frac{x}{x^2 - 1}$. Give the answer as an interval or union of intervals.

ANS:

$$(-\infty, -1) \cup (-1, 1) \cup (1, \infty)$$

PTS: 1

8. Find the domain of the function $f(x) = x^2 - x - 2$.

ANS:

$$(-\infty, \infty)$$

PTS: 1

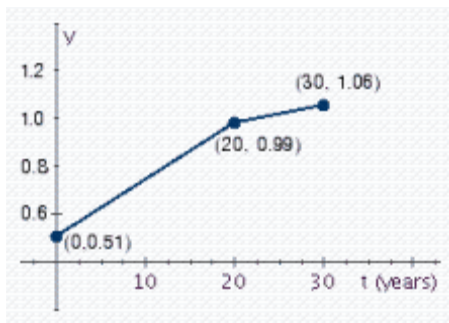
9. The circumference of a circle is given by $C(r) = 2\pi r$, where r is the radius of the circle. What is the circumference of a circle with a 6-in. radius?

ANS:

$$12\pi$$

PTS: 1

10. The following graph shows the ratio of bachelor's degrees earned by women to men from 1960 through 1990.



How fast was the ratio changing in the period from 1960 to 1980?

From 1980 to 1990?

ANS:

$$0.024; 0.007$$

PTS: 1

11. In a certain state, the sales tax T on the amount of taxable goods is 12% of the value of the goods purchased (x), where both T and x are measured in dollars. Express T as a function of x .

ANS:

$$T(x) = 0.12x$$

PTS: 1

12. Ace Truck leases its 10-ft box truck at \$35/day and \$0.45/mi, whereas Acme Truck leases a similar truck at \$30/day and \$0.50/mi. Find the daily cost of leasing from each company as a function of x number of miles driven.

ANS:

$$35 + 0.45x, 30 + 0.5x$$

PTS: 1

13. A study prepared for a Sunbelt town's Chamber of Commerce projected that the population of the town in the next 5 yr will grow according to the rule

$$P(x) = 40,000 + 20x^{\frac{3}{2}} + 10x$$

where $P(x)$ denotes the population x mo from now.

By how much will the population increase during the next 4 mo?

During the next 16 mo?

ANS:

200; 1,440

PTS: 1

14. Determine whether the point $(-6, -12)$ lies on the graph of the function. Answer *yes* or *no*.

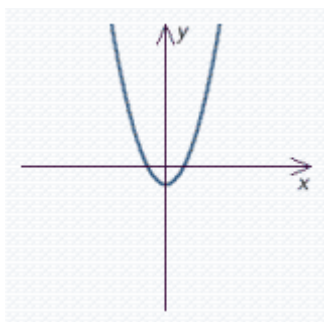
$$f(t) = \frac{|t - 5|}{t + 5}$$

ANS:

no

PTS: 1

15. Use the vertical-line test to determine whether the graph represents y as a function of x . Answer *yes* or *no*.



ANS:

yes

PTS: 1

16. If f is a function, then $f(a + b) = f(a) + f(b)$. Answer *true* or *false*.

ANS:

false

PTS: 1