# Test Bank

# Calculus

## TENTH EDITION


## Ron Larson

## Bruce Edwards



BROOKS/COLE
CENGAGE Learning

Australia • Brazil • Japan • Korea • Mexico • Singapore • Spain • United Kingdom • United States

BROOKS/COLE
CENGAGE Learning



ISBN-13: 978-1-285-09059-7
ISBN-10: 1-285-09059-4

**Brooks/Cole**
20 Channel Center Street
Boston, MA 02210
USA

Cengage Learning is a leading provider of customized learning solutions with office locations around the globe, including Singapore, the United Kingdom, Australia, Mexico, Brazil, and Japan. Locate your local office at:
**www.cengage.com/global**

Cengage Learning products are represented in Canada by Nelson Education, Ltd.

To learn more about Brooks/Cole, visit
**www.cengage.com/brookscole**

Purchase any of our products at your local college store or at our preferred online store
**www.cengagebrain.com**



Printed in the United States of America
1 2 3 4 5 6 7 17 16 15 14 13

# Contents

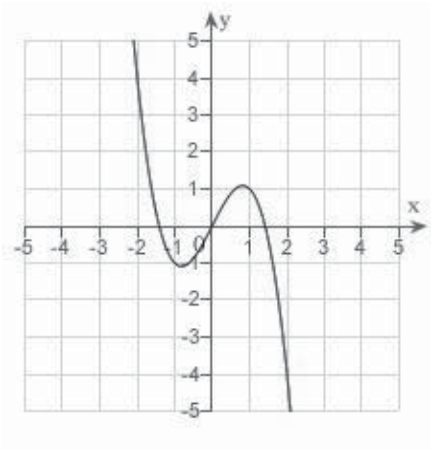
# P.1 Graphs and Models

## Multiple Choice

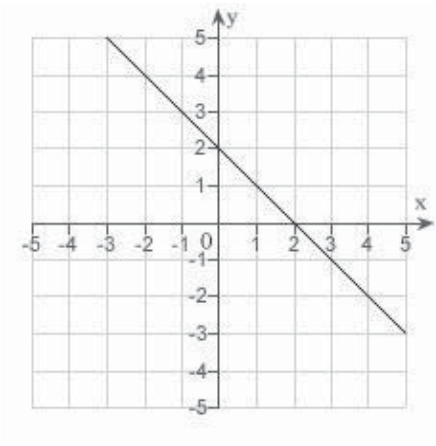
*Identify the choice that best completes the statement or answers the question.*

____ 1. Which of the following is the correct graph of $y = -\sqrt{2 - x^2}$ ?

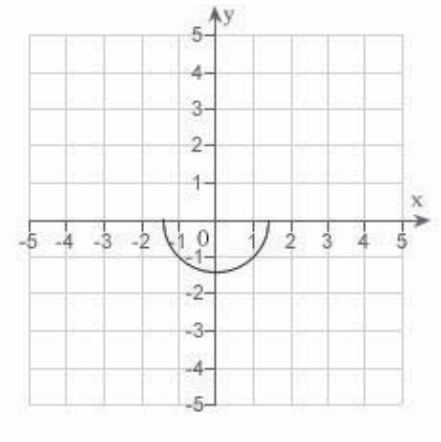
a.



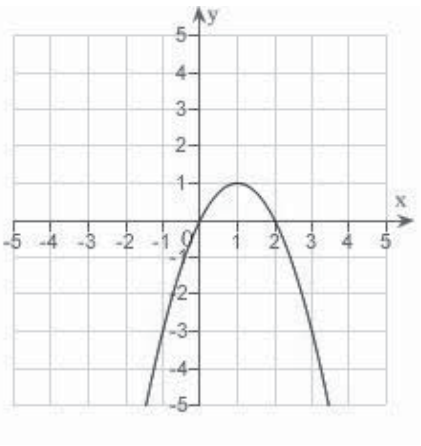

d.



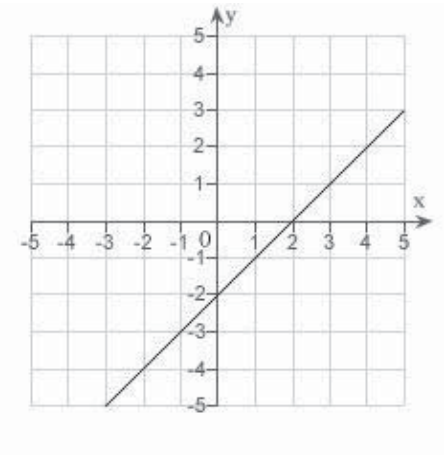

b.




e.

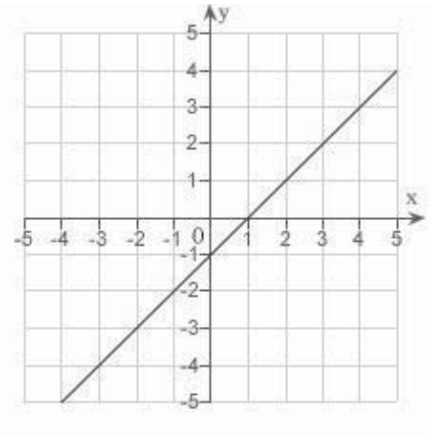



c.

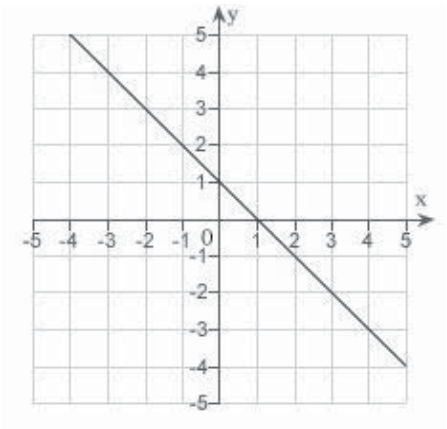


____ 2. Which of the following is the correct graph of $y = x - x^3$?

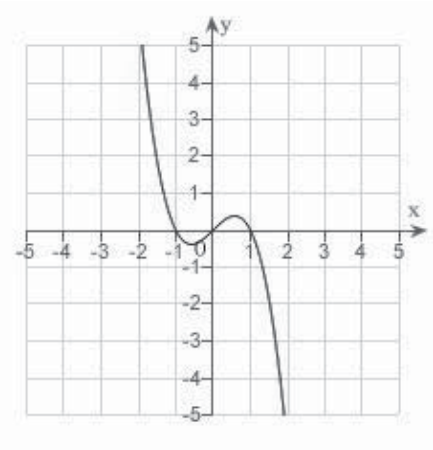
a.



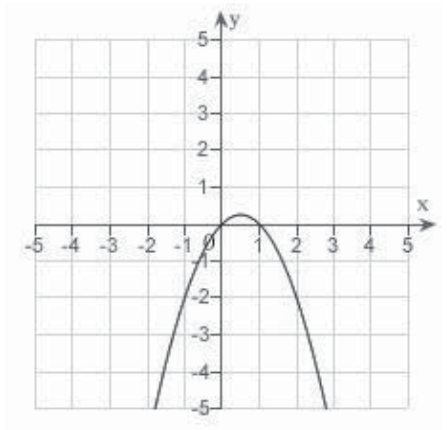

d.



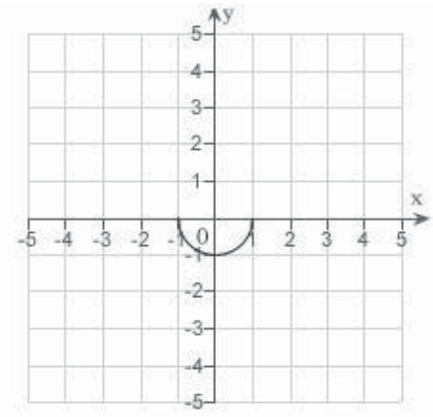

b.




e.




c.



____ 3. Find all intercepts:

$y = x^2 - x - 12$

a. $x$-intercepts: $(4,0)$, $(-3,0)$; $y$-intercepts: $(0, 4)$, $(0, 3)$
b. $x$-intercept: $(12, 0)$; $y$-intercepts: $(0, 4)$, $(0, 3)$
c. $x$-intercepts: $(4, 0)$, $(–3,0)$; $y$-intercept: $(0, -12)$
d. $x$-intercepts: $(4, 0)$, $(-3,0)$; $y$-intercepts: $(0, –12)$, $(0, 12)$
e. $x$-intercept: $(-3, 0)$; $y$-intercept: $(0, –12)$

____ 4. Find all intercepts:

$y = (x + 5)\sqrt{4 - x^2}$

a. $x$-intercepts: $(–5, 0)$, $(–2, 0)$, $(2, 0)$; $y$-intercepts: $(0, 0)$, $(0, 10)$
b. $x$-intercepts: $(–5, 0)$, $(2, 0)$; $y$-intercept: $(0, 10)$
c. $x$-intercepts: $(–5, 0)$, $(2, 0)$; $y$-intercept: $(0, –10)$
d. $x$-intercepts: $(–5, 0)$, $(–2, 0)$, $(2, 0)$; $y$-intercept: $(0, 10)$
e. $x$-intercepts: $(–5, 0)$, $(–2, 0)$, $(2, 0)$; $y$-intercept: $(0, –10)$

____ 5. Test for symmetry with respect to each axis and to the origin.

$x^2y^2 = 8$

a. symmetric with respect to the origin
b. symmetric with respect to the $x$-axis
c. symmetric with respect to the $y$-axis
d. no symmetry
e. A, B, and C

____ 6. Test for symmetry with respect to each axis and to the origin.

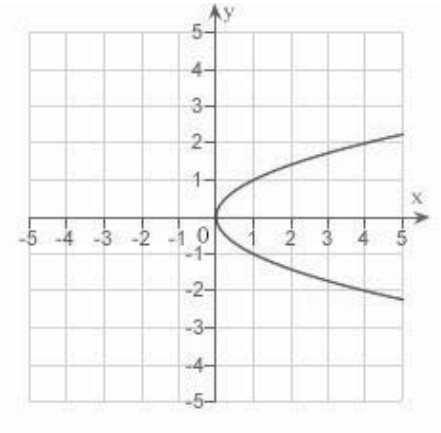
$y = \dfrac{x^2 + 2}{x}$

a. symmetric with respect to the origin
b. symmetric with respect to the $y$-axis
c. symmetric with respect to the $x$-axis
d. both B and C
e. no symmetry

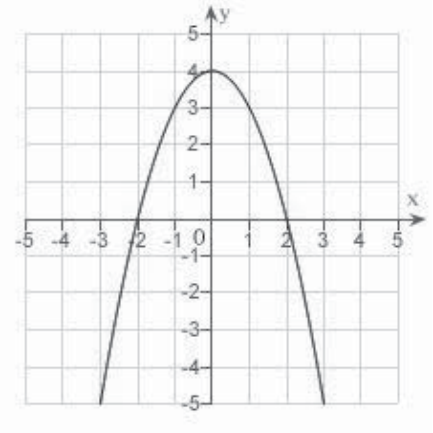
____ 7. Sketch the graph of the equation:

$x = 4 - y^2$

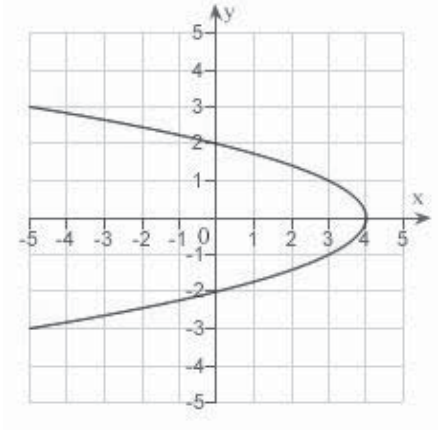
a.



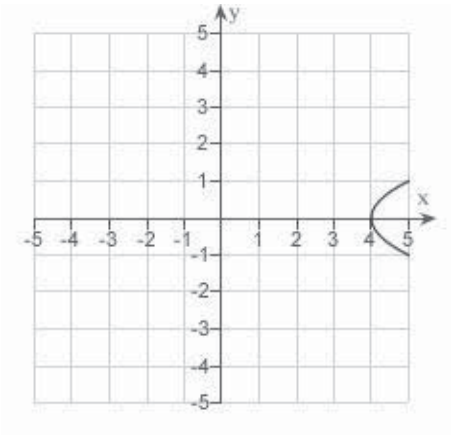

d.



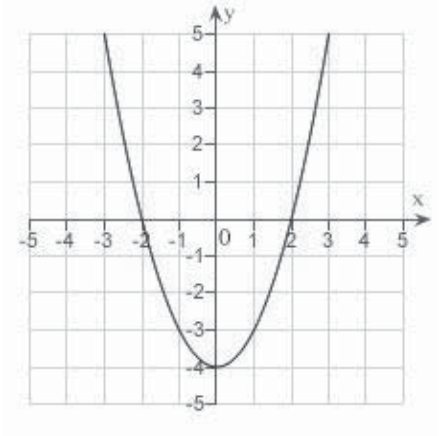

b.




e.



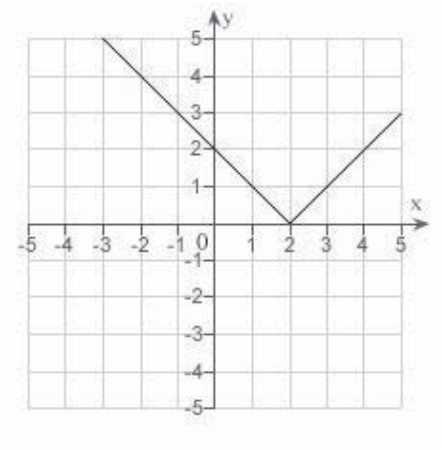

c.



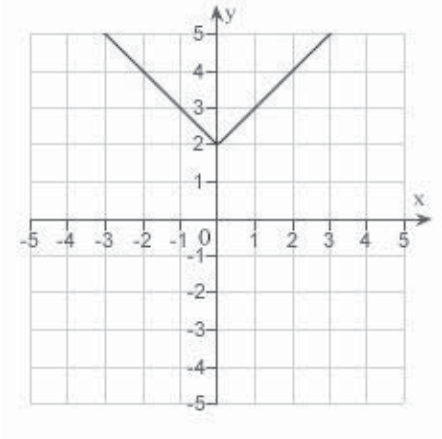
____ 8. Sketch the graph of the equation:

$y = |x + 2|$

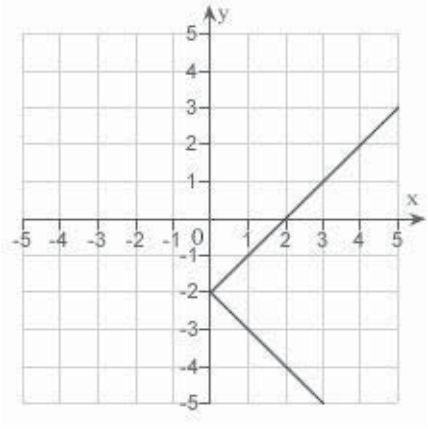
a.



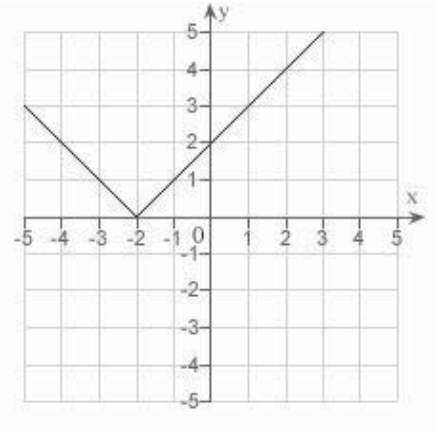

b.




c.




d.




e. none of the above

____ 9. Find the points of intersection of the graphs of the equations:

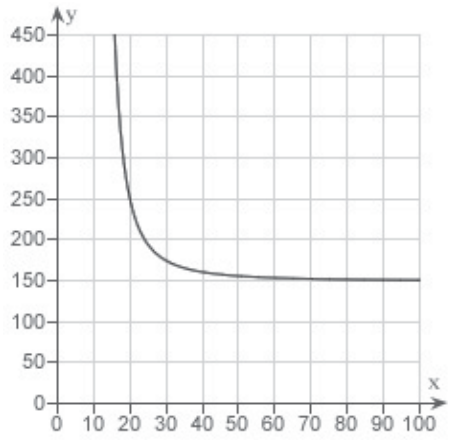
$x = y^2 - 3$

$y = x + 1$

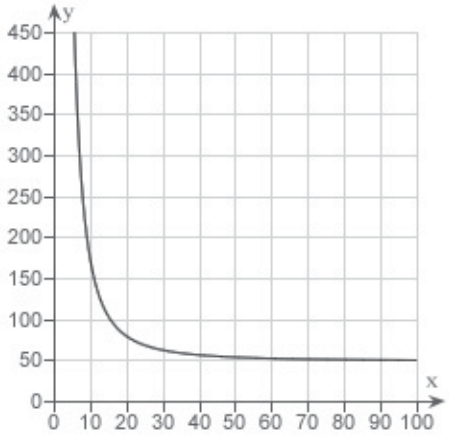
a. $(-2, 1), (-1, 2)$
b. $(-2, 0), (1, 2)$
c. $(-2, -1), (1, 2)$
d. $(2, -1), (-1, 2)$
e. $(-2, -3), (-1, 2)$

____ 10. The resistance $y$ in ohms of 1000 feet of solid metal wire at $77°F$ can be approximated by the model $y = \frac{10,000}{x^2} - 0.57,\ 5 \le x \le 100$, where $x$ is the diameter of the wire in mils (0.001 in). Use a graphing utility to graph the model $y = \frac{10,000}{x^2} - 0.57,\ 5 \le x \le 100.$

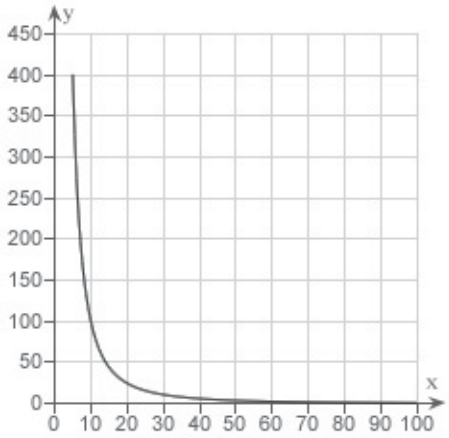
a.



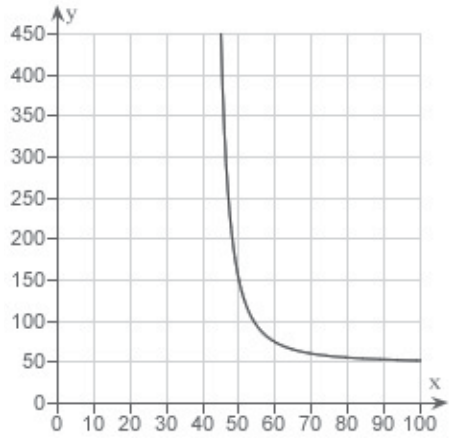

d.



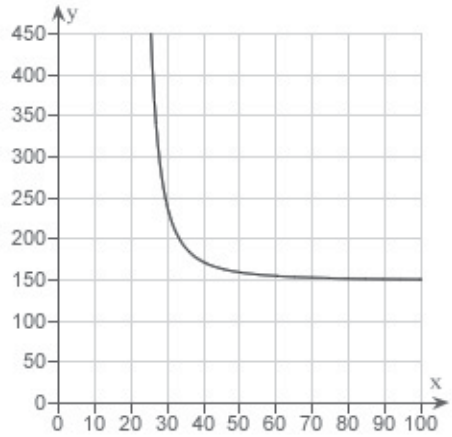
b.




e.




c.




____ 11. The resistance $y$ in ohms of 1000 feet of solid metal wire at $77°F$ can be approximated by the model $y = \frac{12,000}{x^2} - 0.46,\ 5 \le x \le 100,$ where $x$ is the diameter of the wire in mils (0.001 in). If the diameter of the wire is doubled, the resistance is changed by approximately what factor? In determining your answer, you can ignore the constant –0.46.

a. $\frac{1}{2}$
b. $\frac{1}{5}$
c. $4$
d. $5$
e. $\frac{1}{4}$

____ 12. Test for symmetry with respect to each axis and to the origin.

$y = x^2 - 8$

a. symmetric with respect to the origin
b. symmetric with respect to the *y*-axis
c. symmetric with respect to the *x*-axis
d. both B and C
e. no symmetry

____ 13. Test for symmetry with respect to each axis and to the origin.

$|y| - x = 6$

a. symmetric with respect to the origin
b. symmetric with respect to the *x*-axis
c. symmetric with respect to the *y*-axis
d. no symmetry
e. A, B, and C

____ 14. Find all intercepts:

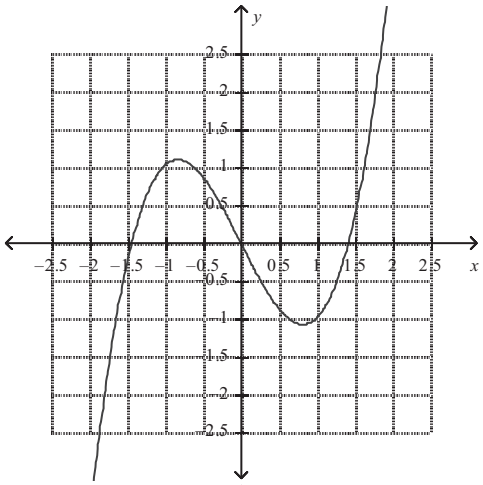
$y^2 = x^3 - 25x$

a. *x*-intercepts: (0,0), (5,0), (-5,0); *y*-intercept: (0, -25)
b. *x*-intercepts: (0,0), (5,0); *y*-intercept: (0, 0)
c. *x*-intercepts: (0,0), (5,0), (-5,0); *y*-intercept: (0, 0)
d. *x*-intercepts: (0,0), (5,0); *y*-intercept: (0, 5)
e. *x*-intercepts: (0,0), (5,0), (25,0); *y*-intercept: (0, 0)

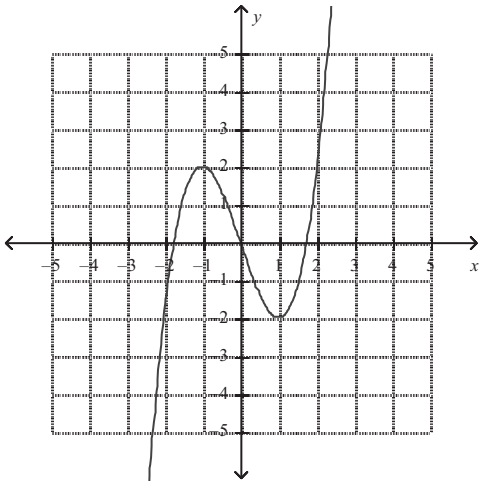
____ 15. Sketch the graph of the equation:

$y = x^3 - 3x$

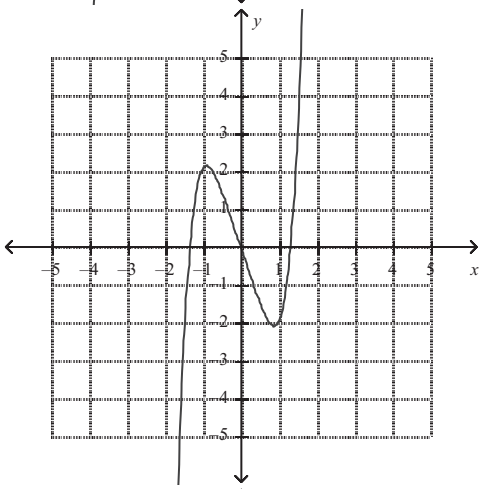
a.



d.

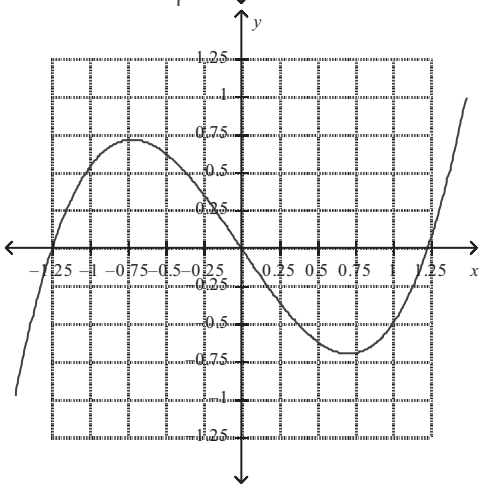


b.



e. none of the above

c.



# P.1 Graphs and Models
# Answer Section

## MULTIPLE CHOICE

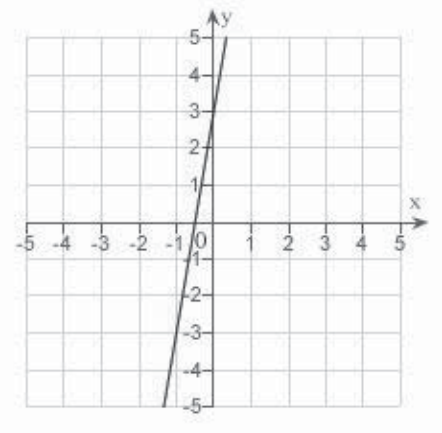
1. ANS: B PTS: 1 DIF: Easy REF: Section 0.1
OBJ: Identify the graph of a semicircle MSC: Skill
2. ANS: B PTS: 1 DIF: Easy REF: Section 0.1
OBJ: Identify the graph of a cubic equation MSC: Skill
3. ANS: C PTS: 1 DIF: Easy REF: Section 0.1
OBJ: Calculate the intercepts of an equation MSC: Skill
4. ANS: D PTS: 1 DIF: Easy REF: Section 0.1
OBJ: Calculate the intercepts of an equation MSC: Skill
5. ANS: E PTS: 1 DIF: Easy REF: Section 0.1
OBJ: Identify the type of symmetry of the graph of an equation MSC: Skill
6. ANS: A PTS: 1 DIF: Easy REF: Section 0.1
OBJ: Identify the type of symmetry of the graph of an equation MSC: Skill
7. ANS: B PTS: 1 DIF: Easy REF: Section 0.1
OBJ: Graph a quadratic equation in y MSC: Skill
8. ANS: D PTS: 1 DIF: Med REF: Section 0.1
OBJ: Graph an absolute value equation MSC: Skill
9. ANS: C PTS: 1 DIF: Med REF: Section 0.1
OBJ: Calculate the points of intersection of the graphs of equations MSC: Skill
10. ANS: B PTS: 1 DIF: Med REF: Section 0.1
OBJ: Plot a rational model using the capabilities of a graphing utility MSC: Application
11. ANS: E PTS: 1 DIF: Med REF: Section 0.1
OBJ: Interpret a rational model MSC: Application
12. ANS: B PTS: 1 DIF: Easy REF: Section 0.1
OBJ: Identify the type of symmetry of the graph of an equation MSC: Skill
13. ANS: B PTS: 1 DIF: Easy REF: Section 0.1
OBJ: Identify the type of symmetry of the graph of an equation MSC: Skill
14. ANS: C PTS: 1 DIF: Easy REF: Section 0.1
OBJ: Calculate the intercepts of an equation MSC: Skill
15. ANS: D PTS: 1 DIF: Easy REF: Section 0.1
OBJ: Graph an equation in y MSC: Skill

## P.2 Linear Models and Rates of Change

### Multiple Choice

*Identify the choice that best completes the statement or answers the question.*

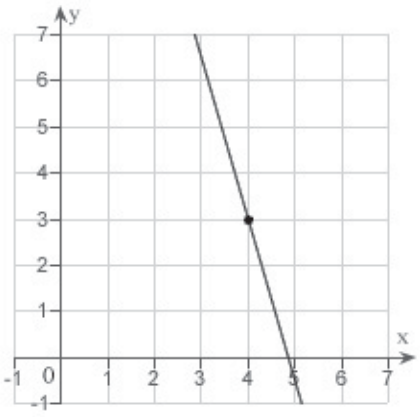
____ 1. Estimate the slope of the line from the graph.



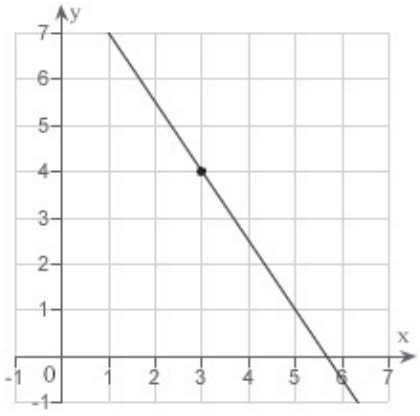

a. 3
b. $-\frac{1}{3}$
c. $-\frac{1}{6}$
d. $\frac{1}{6}$
e. 6

____ 2. Sketch the line passing through the point $(3, 4)$ with the slope $-\frac{3}{2}$.

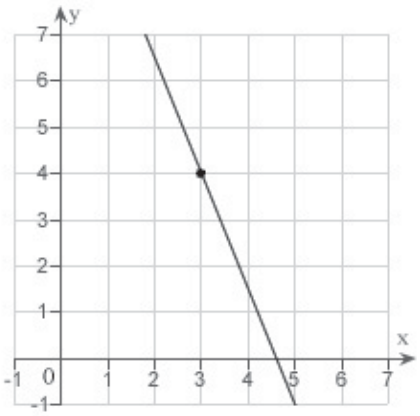
a.



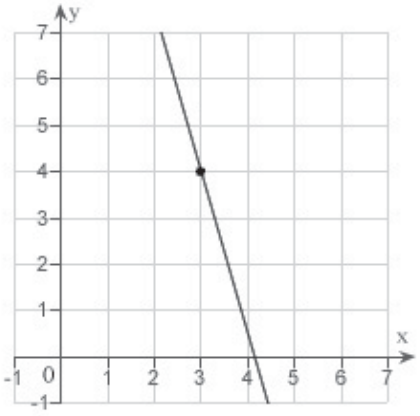

d.



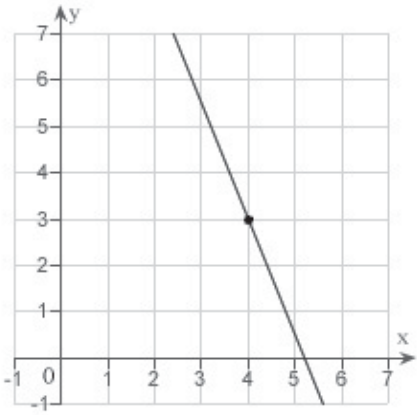
b.




e.




c.




____ 3. Find the slope of the line passing through the pair of points.

$(-3,-6),(0,-11)$

a. $\frac{3}{5}$
b. $-\frac{5}{3}$
c. $\frac{5}{3}$
d. 0
e. $-\frac{3}{5}$

____ 4. Find the slope of the line passing through the points $\left(-\frac{1}{8}, \frac{8}{3}\right)$ and $\left(-\frac{3}{16}, \frac{1}{24}\right)$.

a. 63
b. −21
c. 42
d. 21
e. −42

____ 5. If a line has slope $m = -4$ and passes through the point $(4, 8)$, through which of the following points does the line also pass?

a. $(1, 20)$
b. $(1, 12)$
c. $(1, 0)$
d. $(8, -16)$
e. $(8, -24)$

____ 6. A moving conveyor is built to rise 5 meters for every 7 meters of horizontal change. Find the slope of the conveyor.

a. 0
b. $\frac{5}{7}$
c. $\frac{7}{5}$
d. $-\frac{7}{5}$
e. $-\frac{5}{7}$

____ 7. A moving conveyor is built to rise 1 meter for every 5 meters of horizontal change. Suppose the conveyor runs between two floors in a factory. Find the length of the conveyor if the vertical distance between floors is 10 meters. Round your answer to the nearest meter.

a. 61 meters
b. 39 meters
c. 51 meters
d. 50 meters
e. 41 meters

____ 8. Find the slope of the line $x + 3y = 15$.

a. $\frac{1}{3}$
b. $-\frac{1}{5}$
c. $\frac{1}{5}$
d. $-\frac{1}{15}$
e. $-\frac{1}{3}$

____ 9. Find the $y$-intercept of the line $x + 4y = 8$.

a. $(0, 2)$
b. $(0, 4)$
c. $(0, 8)$
d. $(4, 0)$
e. $(2, 0)$

____ 10. Find an equation of the line that passes through the point $(7, 2)$ and has the slope $m$ that is undefined.

a. $y = 7$
b. $x = 7$
c. $y = 2$
d. $x = 2$
e. $y = 7x$

____ 11. Find an equation of the line that passes through the point $(-11, -9)$ and has the slope $m = \frac{9}{2}$.

a. $y = \frac{9}{2}x - \frac{81}{2}$
b. $y = \frac{9}{2}x + \frac{81}{2}$
c. $y = \frac{9}{2}x + 162$
d. $y = \frac{9}{2}x$
e. $y = -\frac{9}{2}x$

____ 12. Find an equation of the line that passes through the points $(18, -7)$ and $(-18, 23)$.

a. $y = -\frac{5}{6}x - 8$
b. $y = \frac{5}{6}x - 8$
c. $y = \frac{5}{6}x + 8$
d. $y = -\frac{5}{6}x + 8$
e. $y = -\frac{5}{6}x$

____ 13. Find an equation of the line that passes through the points $\left(-\frac{8}{11}, -\frac{70}{11}\right)$ and $\left(\frac{3}{2}, -\frac{21}{4}\right)$.

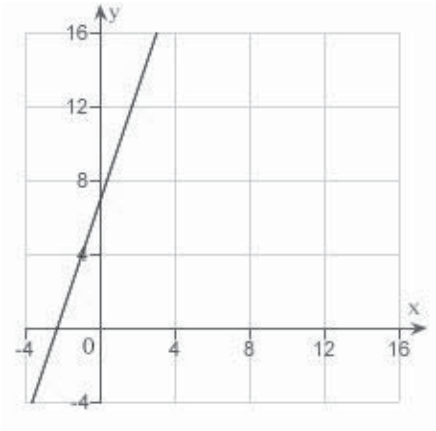
a. $y = \frac{1}{2}x$
b. $y = \frac{1}{2}x + 6$
c. $y = \frac{1}{2}x + 12$
d. $y = \frac{1}{2}x - 12$
e. $y = \frac{1}{2}x - 6$

____ 14. Use the result, "the line with intercepts $(a, 0)$ and $(0, b)$ has the equation $\frac{x}{a} + \frac{y}{b} = 1$, $a \neq 0, b \neq 0$", to write an equation of the line with $x$-intercept: $(8, 0)$ and $y$-intercept: $(0, 7)$.

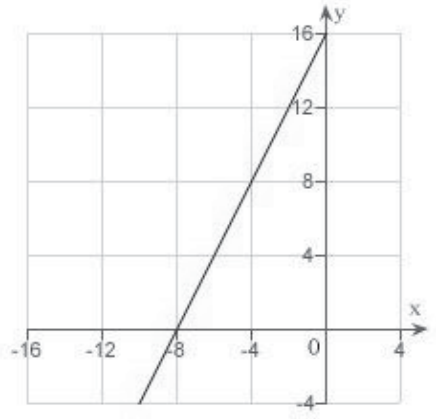
a. $8x - 7y - 8 = 0$
b. $7x - 8y + 7 = 0$
c. $8x + 7y + 8 = 0$
d. $7x + 8y + 56 = 0$
e. $7x + 8y - 56 = 0$

____ 15. Sketch a graph of the equation $y - 8 = 2(x + 4)$.

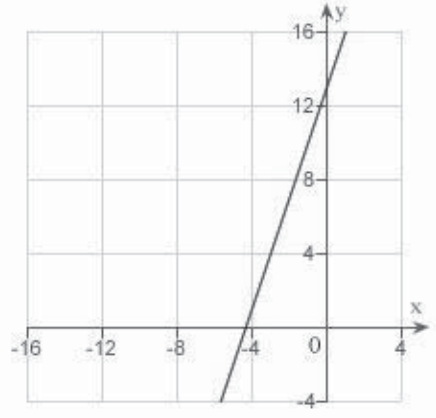
a.



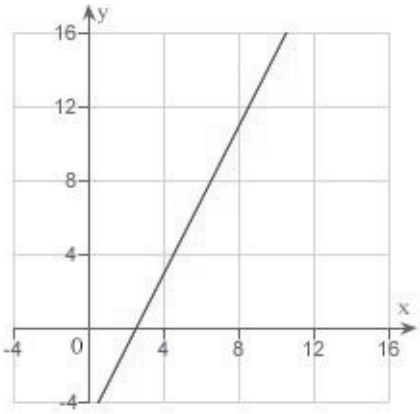

b.



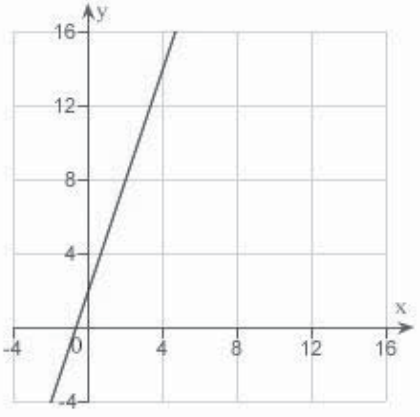

c.




d.




e.



____ 16. Write an equation of the line that passes through the given point and is perpendicular to the given line.

| Point | Line |
|---|---|
| $(-1,-7)$ | $x=6$ |

a. $y=7$
b. $y=-7$
c. $y=-1$
d. $x=-1$
e. $x=1$

____ 17. Write an equation of the line that passes through the given point and is parallel to the given line.

| Point | Line |
|---|---|
| $(3,-4)$ | $-2x-5y=9$ |

a. $-2x-5y=14$
b. $-2x-5y=23$
c. $2x-5y=14$
d. $-2x+5y=-26$
e. $2x-5y=23$

____ 18. Write an equation of the line that passes through the point $(-6,4)$ and is perpendicular to the line $x+y=5$.

a. $x-y+10=0$
b. $x-y+2=0$
c. $x+y-2=0$
d. $x+y+10=0$
e. $x+y-5=0$

____ 19. Write an equation of the line that passes through the point $\left(\frac{5}{4},\frac{5}{8}\right)$ and is parallel to the line $7x-3y=0$.

a. $56x-24y-55=0$
b. $56x+12y-55=0$
c. $56x-8y+55=0$
d. $56x+6y+55=0$
e. $56x+4y-55=0$

____ 20. A real estate office handles an apartment complex with $50$ units. When the rent is $\$800$ per month, all $50$ units are occupied. However, when the rent is $\$845$, the average number of occupied units drops to $47$. Assume that the relationship between the monthly rent $p$ and the demand $x$ is linear. Write a linear equation giving the demand $x$ in terms of the rent $p$.

a. $x = \frac{1}{15}(1595 - p)$

b. $x = \frac{1}{15}(1505 + p)$

c. $x = \frac{1}{45}(1550 + p)$

d. $x = \frac{1}{15}(1550 - p)$

e. $x = \frac{1}{45}(1595 - p)$

____ 21. A real estate office handles an apartment complex with $50$ units. When the rent is $\$600$ per month, all $50$ units are occupied. However, when the rent is $\$645$, the average number of occupied units drops to $47$. Assume that the relationship between the monthly rent $p$ and the demand $x$ is linear. Predict the number of units occupied if the rent is raised to $\$660$.

a. 43 units
b. 54 units
c. 57 units
d. 49 units
e. 46 units

____ 22. Find the distance between the point $(-4, 7)$ and line $x - y - 2 = 0$ using the formula, $\text{Distance} = \frac{|Ax_1 + By_1 + C|}{\sqrt{A^2 + B^2}}$ for the distance between the point $(x_1, y_1)$ and the line $Ax + By + C = 0$.

a. $\frac{11\sqrt{2}}{2}$

b. $\frac{4\sqrt{3}}{3}$

c. $\frac{13\sqrt{2}}{2}$

d. $\frac{9\sqrt{2}}{2}$

e. $\frac{6\sqrt{3}}{3}$

____ 23. Suppose that the dollar value of a product in 2008 is \$174 and the rate at which the value of the product is expected to increase per year during the next 5 years is \$7.50. Write a linear equation that gives the dollar value $V$ of the product in terms of the year $t$. (Let $t = 0$ represent 2000.) Round the numerical values in your answer to one decimal place, where applicable.

a. $V = 7.5t - 159$
b. $V = -7.5t - 114$
c. $V = -7.5t + 174$
d. $V = 7.5t + 114$
e. $V = 7.5t - 144$

____ 24. A company reimburses its sales representatives \$175 per day for lodging and meals plus 45¢ per mile driven. Write a linear equation giving the daily cost $C$ to the company in terms of $x$, the number of miles driven. Round the numerical values in your answer to two decimal places, where applicable.

a. $C = -1.75x + 45$
b. $C = 0.45x + 175$
c. $C = -0.45x - 175$
d. $C = 0.45x - 175$
e. $C = 1.75x - 45$

____ 25. A company reimburses its sales representatives \$160 per day for lodging and meals plus 42¢ per mile driven. How much does it cost the company if a sales representative drives 135 miles on a given day? Round your answer to the nearest cent.

a. 227.20
b. 216.70
c. 136.35
d. 161.35
e. 191.70

## P.2 Linear Models and Rates of Change
## Answer Section

### MULTIPLE CHOICE

1. ANS: E PTS: 1 DIF: Easy REF: Section 0.2
OBJ: Estimate the slope of a line from its graph MSC: Skill
2. ANS: D PTS: 1 DIF: Easy REF: Section 0.2
OBJ: Sketch the line passing through a point with specified slope MSC: Skill
3. ANS: B PTS: 1 DIF: Easy REF: Section 0.2
OBJ: Calculate the slope of a line passing through two points MSC: Skill
4. ANS: C PTS: 1 DIF: Med REF: Section 0.2
OBJ: Calculate the slope of a line passing through two points MSC: Skill
5. ANS: A PTS: 1 DIF: Med REF: Section 0.2
OBJ: Identify a point on a line with specified properties MSC: Skill
6. ANS: B PTS: 1 DIF: Easy REF: Section 0.2
MSC: Application
7. ANS: C PTS: 1 DIF: Med REF: Section 0.2
OBJ: Calculate slopes in applications MSC: Application
8. ANS: E PTS: 1 DIF: Med REF: Section 0.2
OBJ: Manipulate a linear equation to determine its slope MSC: Skill
9. ANS: A PTS: 1 DIF: Med REF: Section 0.2
OBJ: Manipulate a linear equation to determine its y-intercept MSC: Skill
10. ANS: B PTS: 1 DIF: Easy REF: Section 0.2
OBJ: Write an equation of a line given a point on the line and its slope MSC: Skill
11. ANS: B PTS: 1 DIF: Easy REF: Section 0.2
OBJ: Write an equation of a line given a point on the line and its slope MSC: Skill
12. ANS: D PTS: 1 DIF: Easy REF: Section 0.2
OBJ: Write an equation of a line given two points on the line MSC: Skill
13. ANS: E PTS: 1 DIF: Med REF: Section 0.2
OBJ: Write an equation of a line given two points on the line MSC: Skill
14. ANS: E PTS: 1 DIF: Easy REF: Section 0.2
OBJ: Write an equation of a line given its x- and y-intercepts MSC: Skill
15. ANS: B PTS: 1 DIF: Med REF: Section 0.2
OBJ: Sketch the graph of a linear equation MSC: Skill
16. ANS: C PTS: 1 DIF: Med REF: Section 0.2
OBJ: Write an equation of a line given a point on the line and a line to which it is parallel/perpendicular MSC: Skill
17. ANS: A PTS: 1 DIF: Med REF: Section 0.2
OBJ: Write an equation of a line given a point on the line and a line to which it is parallel/perpendicular MSC: Skill
18. ANS: A PTS: 1 DIF: Med REF: Section 0.2
OBJ: Write an equation of a line given a point on the line and a line to which it is perpendicular
MSC: Skill
19. ANS: A PTS: 1 DIF: Easy REF: Section 0.2
OBJ: Write an equation of a line given a point on the line and a line to which it is parallel
MSC: Skill

20. ANS: D PTS: 1 DIF: Med REF: Section 0.2
OBJ: Write linear equations in applications MSC: Application
21. ANS: E PTS: 1 DIF: Easy REF: Section 0.2
OBJ: Evaluate linear equations in applications MSC: Application
22. ANS: C PTS: 1 DIF: Med REF: Section 0.2
OBJ: Calculate the distance between a point and a line MSC: Skill
23. ANS: D PTS: 1 DIF: Easy REF: Section 0.2
OBJ: Write linear equations in applications MSC: Application
24. ANS: B PTS: 1 DIF: Easy REF: Section 0.2
OBJ: Write linear equations in applications MSC: Application
25. ANS: B PTS: 1 DIF: Easy REF: Section 0.2
OBJ: Evaluate linear equations in applications MSC: Application

## P.3 Functions and Their Graphs

### Multiple Choice

*Identify the choice that best completes the statement or answers the question.*

____ 1. Evaluate (if possible) the function $f(x) = -6x - 5$ at $x = -2$. Simplify the result.

a. –7
b. 17
c. 3
d. 7
e. undefined

____ 2. Evaluate (if possible) the function $f(x) = \sqrt{x-5}$ at $x = 9$. Simplify the result.

a. 3
b. 2
c. $-2$
d. 4
e. undefined

____ 3. Evaluate (if possible) the function $g(x) = x^2(x+2)$ at $x = t - 6$. Simplify the result.

a. $t^3 - 4t^2 + 12t - 144$
b. $t^3 - 4t^2 + 84t - 144$
c. $t^3 - 16t^2 + 84t - 144$
d. $t^3 - 16t^2 + 12t - 144$
e. none of the above

____ 4. Let $f(x) = 14x + 8$. Then simplify the expression $\dfrac{f(x) - f(9)}{x - 9}$.

a. 15
b. 14
c. 19
d. 11
e. undefined

____ 5. Let $g(x) = \dfrac{1}{\sqrt{x+15}}$. Evaluate the expression $\dfrac{g(x) - g(-11)}{x+11}$ and then simplify the result.

a. $\dfrac{2\sqrt{x+15} - x - 15}{2(x+11)(x+15)}$
b. $\dfrac{2\sqrt{x+15} + x - 15}{2(x-11)(x+15)}$
c. $\dfrac{2\sqrt{x+15} + x - 15}{2(x+11)(x+15)}$
d. $\dfrac{2\sqrt{x+15} - x - 15}{2(x-11)(x+15)}$
e. undefined

____ 6. Find the domain and range of the function $f(x) = x^2 - 6$.

a. domain: $[-6, \infty)$
range: $[-6, \infty)$
b. domain: $[-6, \infty)$
range: $(-6, \infty)$
c. domain: $(-\infty, \infty)$
range: $(-6, \infty)$
d. domain: $(-\infty, \infty)$
range: $[6, \infty)$
e. domain: $(-\infty, \infty)$
range: $[-6, \infty)$

____ 7. Find the domain and range of the function $g(t) = \sqrt{t-10}$.

a. domain: $[10, \infty)$
range: $(0, \infty)$
b. domain: $(10, \infty)$
range: $[0, \infty)$
c. domain: $[10, \infty)$
range: $(-\infty, \infty)$
d. domain: $[0, \infty)$
range: $[10, \infty)$
e. none of the above

____ 8. Find the domain and range of the function $h(x) = \dfrac{11}{x+6}$.

a. domain: $(-\infty, -6) \cup (-6, \infty)$
range: $(-\infty, \infty)$
b. domain: $(-\infty, -6) \cup (-6, \infty)$
range: $(-\infty, 0) \cup (0, \infty)$
c. domain: $(-\infty, -6] \cup [-6, \infty)$
range: $(-\infty, 0) \cup (0, \infty)$
d. domain: $(-\infty, -6)$
range: $(0, \infty)$
e. domain: $(-6, \infty)$
range: $(0, \infty)$

____ 9. Evaluate the function $f(x) = \begin{cases} 2x+1, & x < 0 \\ 2x+2, & x \geq 0 \end{cases}$ at $f(5)$.

a. $f(5) = 6$
b. $f(5) = 5$
c. $f(5) = 13$
d. $f(5) = 11$
e. $f(5) = 12$

____ 10. Determine the domain and range of the function $f(x) = \begin{cases} 3x+2, & x < 0 \\ 3x+6, & x \geq 0 \end{cases}$.

a. domain: $(-\infty, 2)$
range: $(-\infty, 2) \cap [6, \infty]$
b. domain: $(-\infty, \infty)$
range: $(-\infty, 2) \cup [6, \infty)$
c. domain: $(-\infty, \infty)$
range: $(-\infty, 2) \cup (\infty, 6]$
d. domain: $(-\infty, \infty)$
range: $(\infty, 2) \cup (6, -\infty)$
e. domain: $(-\infty, 3)$
range: $(-\infty, 2) \cap [6, \infty)$

____ 11. Determine whether $y$ is a function of $x$.

$y - 5x^2 = 6$

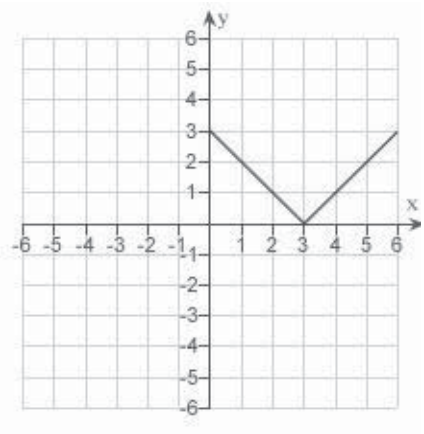
a. no
b. yes

____ 12. Determine whether $y$ is a function of $x$.

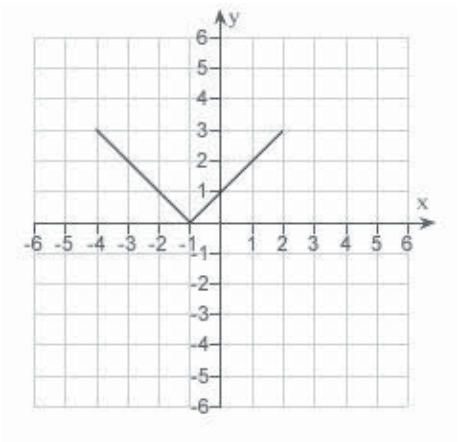
$xy - x^2 = 3y + x$

a. no
b. yes

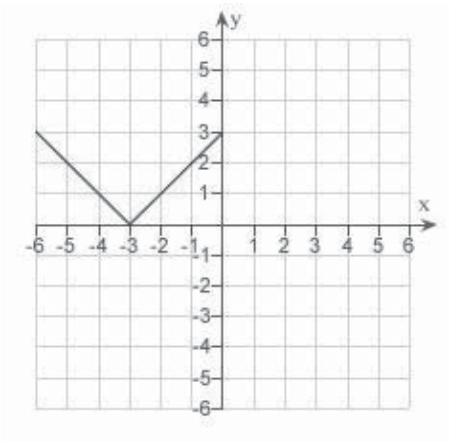
____ 13. Use the graph of $y = f(x)$ given below to find the graph of the function $y = f(x + 5)$.



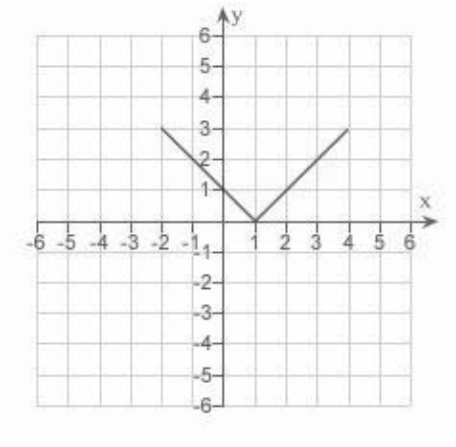

a.



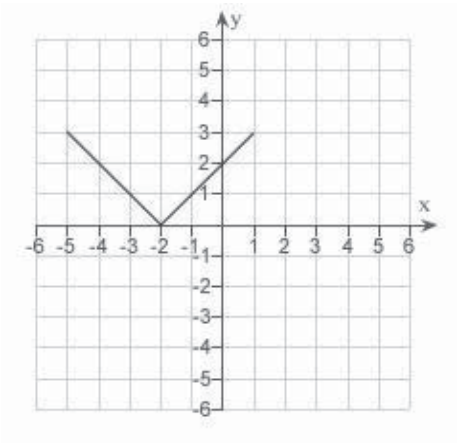

d.



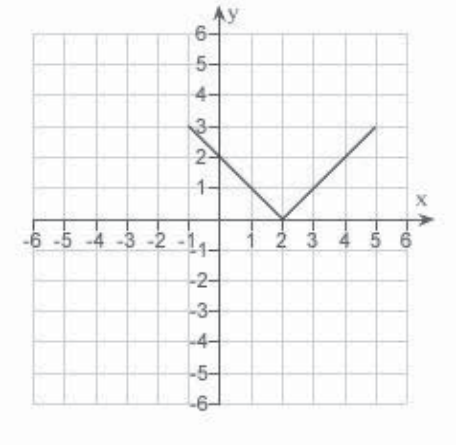
b.



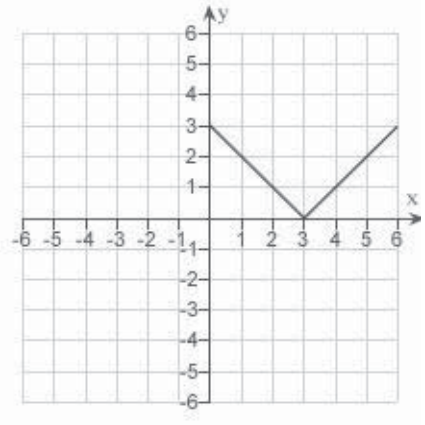

e.



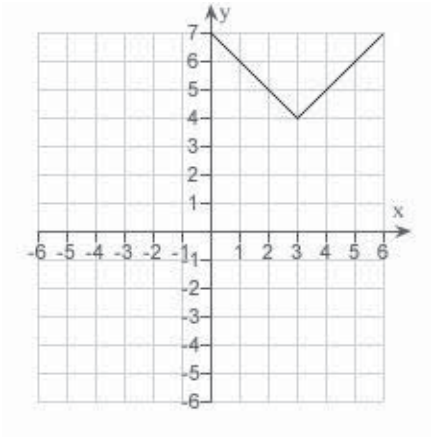

c.



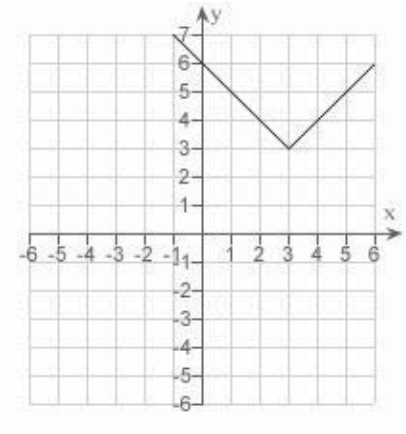

____ 14. Use the graph of $y = f(x)$ given below to find the graph of the function $y = f(x) + 4$.



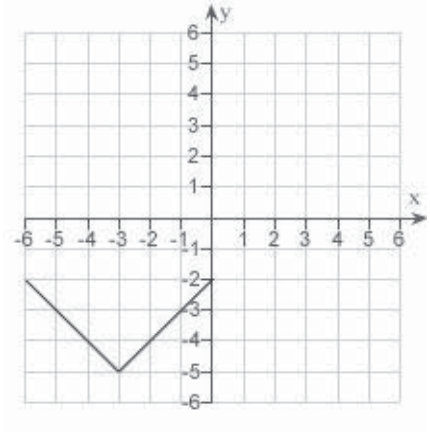
a.



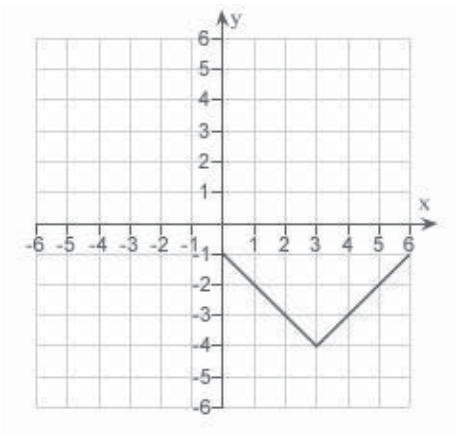

b.



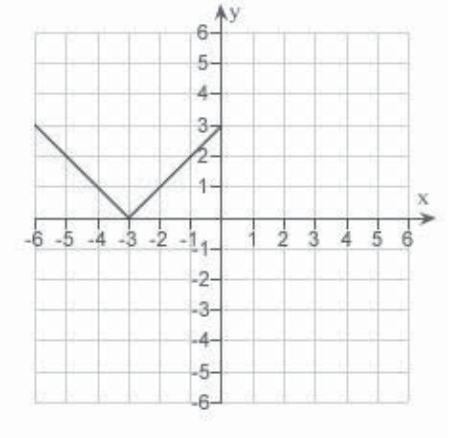

c.




d.




e.



____ 15. Given $f(x) = \cos x$ and $g(x) = \frac{\pi}{2}x$, evaluate $f(g(2))$.

a. 0
b. $\frac{1}{2}$
c. $\frac{\pi}{2}\sin(2)$
d. $-1$
e. $\frac{\pi}{2}\cos(2)$

____ 16. Determine whether the function is even, odd, or neither.

$f(x) = x^2(3-x)^2$

a. odd
b. even
c. neither

____ 17. Determine whether the function is even, odd, or neither.

$f(x) = x\sin 2x$

a. even
b. odd
c. neither

____ 18. Find the coordinates of a second point on the graph of a function *f* if the given point $\left(-\frac{6}{5}, 8\right)$ is on the graph and the function is even.

a. $\left(8, -\frac{6}{5}\right)$
b. $\left(-8, -\frac{6}{5}\right)$
c. $\left(-\frac{6}{5}, -8\right)$
d. $\left(\frac{6}{5}, -8\right)$
e. $\left(\frac{6}{5}, 8\right)$

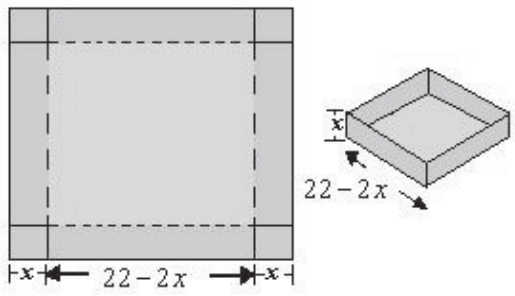
____ 19. Find the coordinates of a second point on the graph of a function *f* if the given point $\left(-\frac{9}{8}, 5\right)$ is on the graph and the function is odd.

a. $\left(-5, -\frac{9}{8}\right)$
b. $\left(\frac{9}{8}, -5\right)$
c. $\left(-5, \frac{9}{8}\right)$
d. $\left(-\frac{9}{8}, -5\right)$
e. $\left(\frac{9}{8}, 5\right)$

____ 20. The horsepower *H* required to overcome wind drag on a certain automobile is approximated by $H(x) = 0.002x^2 + 0.005x - 0.027, \ 10 \le x \le 100$ where *x* is the speed of the car in miles per hour. Find $H\left(\frac{x}{1.1}\right)$. Round the numerical values in your answer to five decimal places.

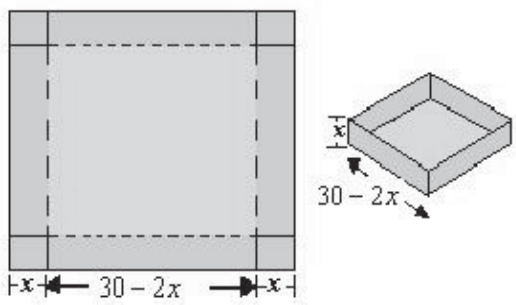
a. $H\left(\frac{x}{1.1}\right) = 0.00150x^2 + 0.00455x - 0.02700$
b. $H\left(\frac{x}{1.1}\right) = 0.00150x^2 + 0.00165x - 0.00455$
c. $H\left(\frac{x}{1.1}\right) = 0.00165x^2 + 0.00150x - 0.02700$
d. $H\left(\frac{x}{1.1}\right) = 0.00165x^2 + 0.00455x - 0.02700$
e. $H\left(\frac{x}{1.1}\right) = 0.00455x^2 + 0.00165x - 0.02700$

____ 21. An open box of maximum volume is to be made from a square piece of material 22 centimeters on a side by cutting equal squares from the corners and turning up the sides (see figure). Write the volume $V$ as a function of $x$, the length of the corner squares.




a. $V = x(22 - 2x)^2$
b. $V = x + (22 - x)^2$
c. $V = x^2 + (22 - 2x)$
d. $V = x^2(22 - 2x)$
e. $V = x(22 - 2x)$

____ 22. An open box of maximum volume is to be made from a square piece of material 30 centimeters on a side by cutting equal squares from the corners and turning up the sides(see figure). What is the domain of the function $V = x(30 - 2x)^2$.




a. domain: $0 < x < \infty$
b. domain: 30
c. domain: $0 < x < 15$
d. domain: $0 < x < 30$
e. domain: 15

## P.3 Functions and Their Graphs
## Answer Section

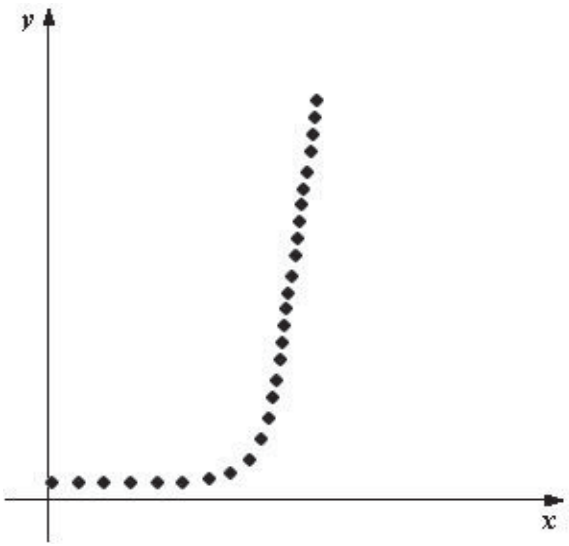
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | ANS: | D | PTS: | 1 | DIF: | Easy | REF: | Section 0.3 | |
| OBJ: | Evaluate a function and simplify | | | | | | MSC: | Skill | |
| 2. | ANS: | B | PTS: | 1 | DIF: | Easy | REF: | Section 0.3 | |
| OBJ: | Evaluate a function and simplify | | | | | | MSC: | Skill | |
| 3. | ANS: | C | PTS: | 1 | DIF: | Easy | REF: | Section 0.3 | |
| OBJ: | Evaluate a function and simplify | | | | | | MSC: | Skill | |
| 4. | ANS: | B | PTS: | 1 | DIF: | Med | REF: | Section 0.3 | |
| OBJ: | Simplify a difference quotient | | | | | | MSC: | Skill | |
| 5. | ANS: | A | PTS: | 1 | DIF: | Med | REF: | Section 0.3 | |
| OBJ: | Simplify a difference quotient | | | | | | MSC: | Skill | |
| 6. | ANS: | E | PTS: | 1 | DIF: | Easy | REF: | Section 0.3 | |
| OBJ: | Identify the domain and range of a function | | | | | | MSC: | Skill | |
| 7. | ANS: | E | PTS: | 1 | DIF: | Easy | REF: | Section 0.3 | |
| OBJ: | Identify the domain and range of a function | | | | | | MSC: | Skill | |
| 8. | ANS: | B | PTS: | 1 | DIF: | Easy | REF: | Section 0.3 | |
| OBJ: | Identify the domain and range of a function | | | | | | MSC: | Skill | |
| 9. | ANS: | E | PTS: | 1 | DIF: | Easy | REF: | Section 0.3 | |
| OBJ: | Evaluate a piecewise function | | | | | | MSC: | Skill | |
| 10. | ANS: | B | PTS: | 1 | DIF: | Easy | REF: | Section 0.3 | |
| OBJ: | Identify the domain and range of a function | | | | | | MSC: | Skill | |
| 11. | ANS: | B | PTS: | 1 | DIF: | Easy | REF: | Section 0.3 | |
| OBJ: | Identify equations that are functions | | | | | | MSC: | Skill | |
| 12. | ANS: | B | PTS: | 1 | DIF: | Easy | REF: | Section 0.3 | |
| OBJ: | Identify equations that are functions | | | | | | MSC: | Skill | |
| 13. | ANS: | E | PTS: | 1 | DIF: | Easy | REF: | Section 0.3 | |
| OBJ: | Graph transformations of functions | | | | | | MSC: | Skill | |
| 14. | ANS: | A | PTS: | 1 | DIF: | Med | REF: | Section 0.3 | |
| OBJ: | Graph transformations of functions | | | | | | MSC: | Skill | |
| 15. | ANS: | D | PTS: | 1 | DIF: | Easy | REF: | Section 0.3 | |
| OBJ: | Evaluate composite functions | | | | | | MSC: | Skill | |
| 16. | ANS: | C | PTS: | 1 | DIF: | Easy | REF: | Section 0.3 | |
| OBJ: | Identify the type of symmetry of the graph of a function | | | | | | MSC: | Skill | |
| 17. | ANS: | A | PTS: | 1 | DIF: | Easy | REF: | Section 0.3 | |
| OBJ: | Identify the type of symmetry of the graph of a function | | | | | | MSC: | Skill | |
| 18. | ANS: | E | PTS: | 1 | DIF: | Easy | REF: | Section 0.3 | |
| OBJ: | Identify points on a graph using symmetry | | | | | | MSC: | Skill | |
| 19. | ANS: | B | PTS: | 1 | DIF: | Easy | REF: | Section 0.3 | |
| OBJ: | Identify points on a graph using symmetry | | | | | | MSC: | Skill | |
| 20. | ANS: | D | PTS: | 1 | DIF: | Med | REF: | Section 0.3 | |
| OBJ: | Apply composite functions | | | | | | MSC: | Application | |
| 21. | ANS: | A | PTS: | 1 | DIF: | Med | REF: | Section 0.3 | |
| OBJ: | Create functions in applications | | | | | | MSC: | Application | |
| 22. | ANS: | C | PTS: | 1 | DIF: | Med | REF: | Section 0.3 | |
| OBJ: | Identify domains in applications | | | | | | MSC: | Application | |

## P.4 Fitting Models to Data

### Multiple Choice

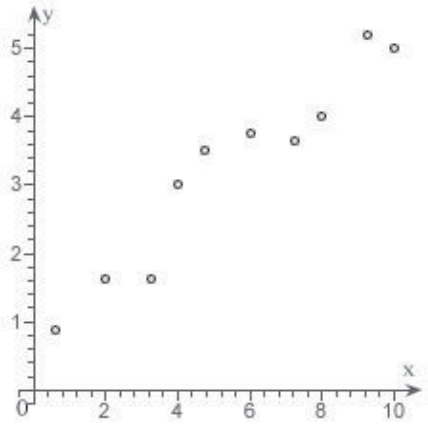
*Identify the choice that best completes the statement or answers the question.*

____ 1. Determine which type of function would be most appropriate to fit the given data.




a. exponential
b. linear
c. quadratic
d. no relationship
e. trigonometric

____ 2. Which function below would be most appropriate model for the given data?




a. no apparent relationship between x and y
b. trigonometric
c. quadratic
d. linear

____ 3. Hooke's Law states that the force $F$ required to compress or stretch a spring (within its elastic limits) is proportional to the distance $d$ that the spring is compressed or stretched from its original length. That is, $F = kd$ where $k$ is a measure of the stiffness of the spring and is called the spring constant. The table shows the elongation $d$ in centimeters of a spring when a force of $F$ newtons is applied. Use the regression capabilities of a graphing utility to find a linear model for the data. Round the numerical values in your answer to three decimal places.

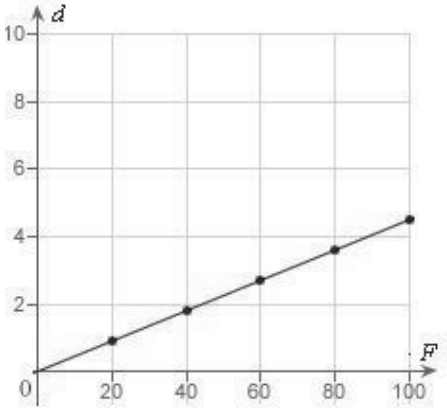
| $F$ | 20 | 40 | 60 | 80 | 100 |
|---|---|---|---|---|---|
| $d$ | 1.9 | 3.8 | 5.7 | 7.6 | 9.5 |

a. $d = 0.675F$
b. $d = 0.118F$
c. $d = 0.112F$
d. $d = 0.095F$
e. $d = 0.905F$

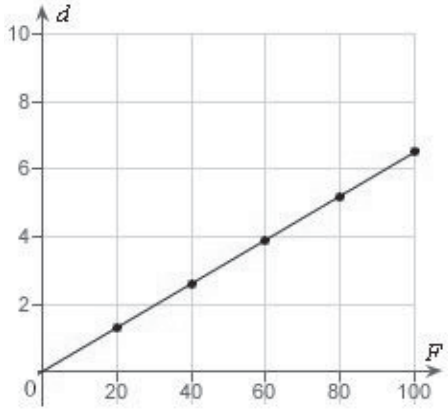
____ 4. Hooke's Law states that the force $F$ required to compress or stretch a spring (within its elastic limits) is proportional to the distance $d$ that the spring is compressed or stretched from its original length. That is, $F = kd$ where $k$ is a measure of the stiffness of the spring and is called the spring constant. The table shows the elongation $d$ in centimeters of a spring when a force of $F$ newtons is applied. Use a graphing utility to plot the data and graph the linear model.

| $F$ | 20 | 40 | 60 | 80 | 100 |
|---|---|---|---|---|---|
| $d$ | 1.3 | 2.6 | 3.9 | 5.2 | 6.5 |

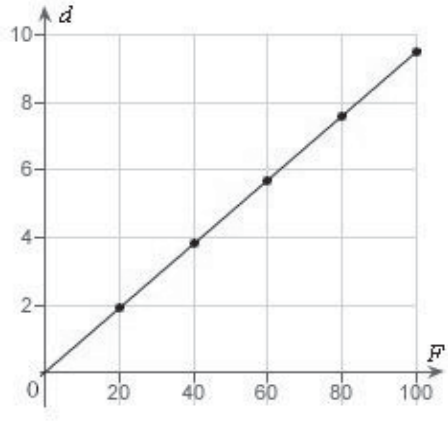
a.



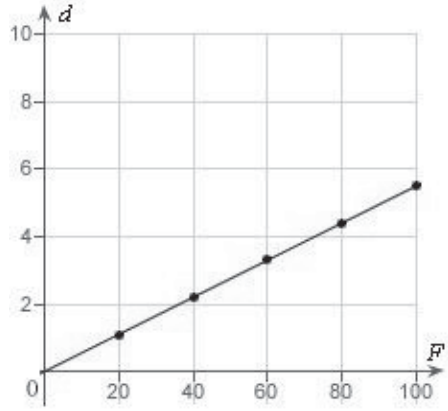

d.



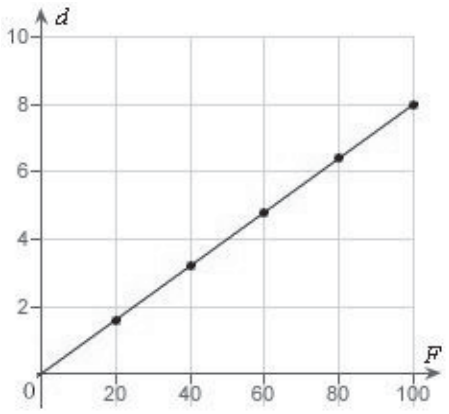

b.




e.



c.




____ 5. Hooke's Law states that the force $F$ required to compress or stretch a spring (within its elastic limits) is proportional to the distance $d$ that the spring is compressed or stretched from its original length. That is, $F = kd$ where $k$ is a measure of the stiffness of the spring and is called the spring constant. The table shows the elongation $d$ in centimeters of a spring when a force of $F$ newtons is applied. Use the model $d = 0.085F$ to estimate the elongation of the spring when a force of 55 newtons is applied. Round your answer to two decimal places.

| $F$ | 20 | 40 | 60 | 80 | 100 |
|---|---|---|---|---|---|
| $d$ | 1.7 | 3.4 | 5.1 | 6.8 | 8.5 |

a. 8.08 cm
b. 6.38 cm
c. 4.68 cm
d. 2.98 cm
e. 9.78 cm

____ 6. In an experiment, students measured the speed $s$ (in meters per second) of a falling object $t$ seconds after it was released. The results are shown in the table below. Use the regression capabilities of a graphing utility to find a linear model for the data. Round all numerical values in your answer to one decimal place.

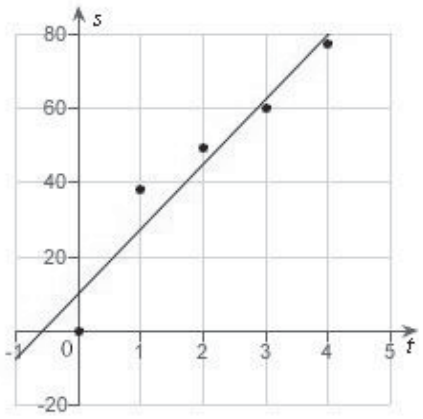
| $t$ | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| $s$ | 0 | 13.0 | 21.4 | 31.2 | 41.4 |

a. $s = 10.1t + 1.2$
b. $s = 3.0t - 1.2$
c. $s = 1.2t + 10.1$
d. $s = 10.1t + 3.0$
e. $s = 1.2t - 3.0$

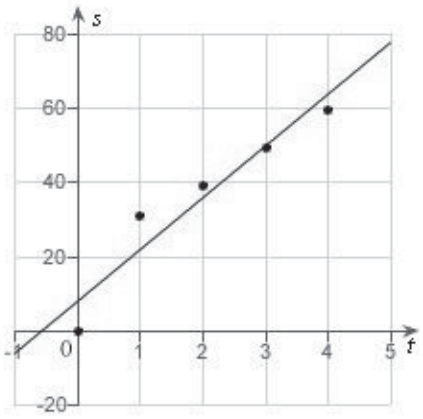
____ 7. In an experiment, students measured the speed $s$ (in meters per second) of a falling object $t$ seconds after it was released. The results are shown in the table below. Use the regression capabilities of a graphing utility to find a linear model for the data. Round all numerical values in your answer to one decimal place.

| $t$ | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| $s$ | 0 | 40 | 48.4 | 58.2 | 68.4 |

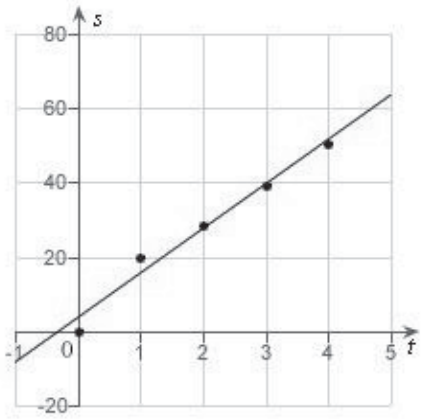
a.



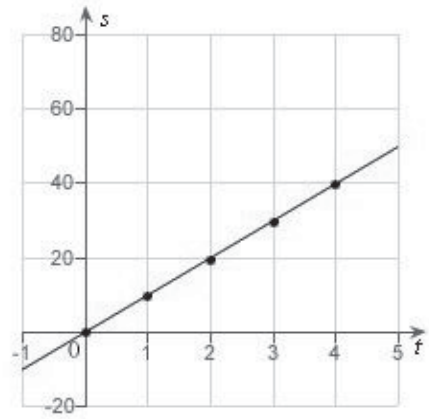

d.



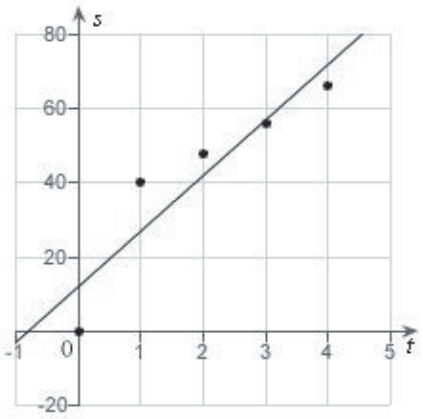

b.




e.



c.




____ 8. In an experiment, students measured the speed $s$ (in meters per second) of a falling object $t$ seconds after it was released. The results are shown in the table below. Use the model $s = 11.9t + 4.8$ to estimate the speed of the object after $1.5$ seconds. Round your answer to two decimal places.

| $t$ | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| $s$ | 0 | 22.0 | 30.4 | 40.2 | 50.4 |

a. 21.05 meters/second
b. 20.95 meters/second
c. 24.25 meters/second
d. 23.55 meters/second
e. 22.65 meters/second

____ 9. Students in a lab measured the breaking strength $S$ (in pounds) of wood 2 inches thick, $x$ inches high, and 12 inches long. The results are shown in the table below. Use the regression capabilities of a graphing utility to fit a quadratic model to the data. Round the numerical values in your answer to two decimal places, where applicable.

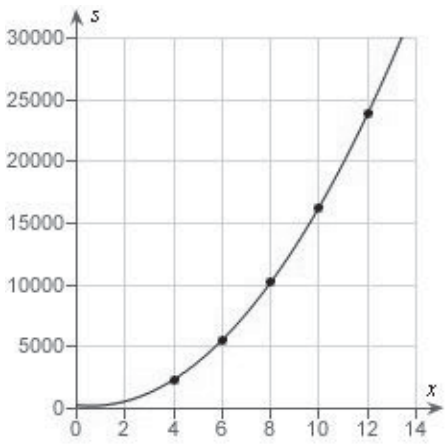
| $x$ | 4 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|
| $S$ | 2422 | 5512 | 10,362 | 16,302 | 23,912 |

a. $S = 170.89x^2 - 209.79x + 324$
b. $S = 180.89x^2 - 205.79x + 324$
c. $S = 190.89x^2 + 201.79x + 331$
d. $S = 170.89x^2 - 209.79x + 327$
e. $S = 180.89x^2 + 203.79x - 331$

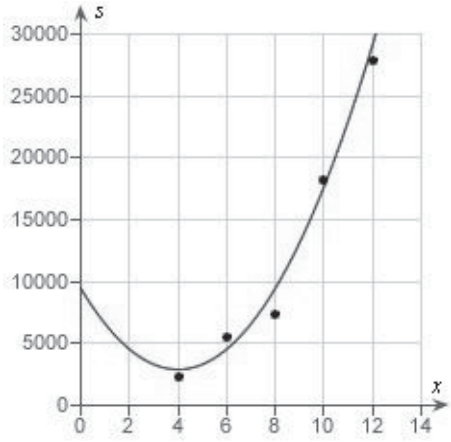
____ 10. Students in a lab measured the breaking strength $S$ (in pounds) of wood 2 inches thick, $x$ inches high, and 12 inches long. The results are shown in the table below. Use a graphing utility to plot the data and graph the quadratic model.

| $x$ | 4 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|
| $S$ | 2370 | 4460 | 13,310 | 19,250 | 29,860 |

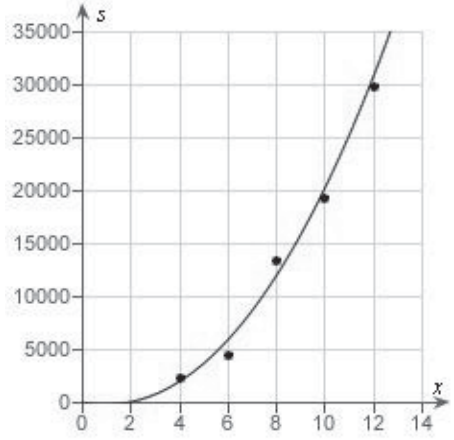
a.



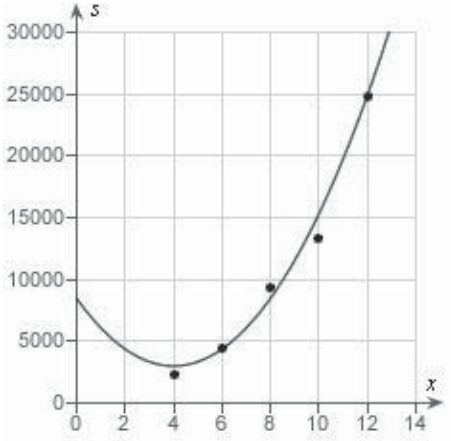

d.



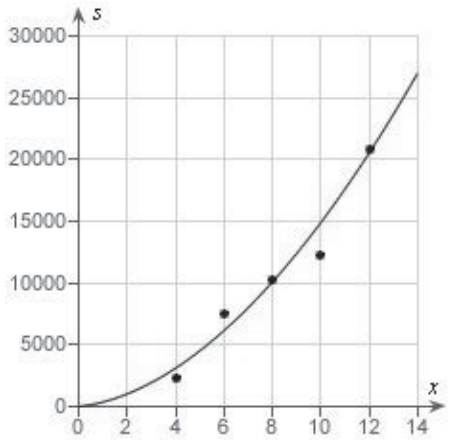

b.




e.



c.




____ 11. Students in a lab measured the breaking strength $S$ (in pounds) of wood 2 inches thick, $x$ inches high, and 12 inches long. The results are shown in the table below. Use the model $S = 180.89x^2 - 205.79x + 284$ to approximate the breaking strength when $x = 2$. Round your answer to two decimal places.

| $x$ | 4 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|
| $S$ | 2382 | 5472 | 10,322 | 16,262 | 23,872 |

a. 595.98 pounds
b. 390.19 pounds
c. 957.76 pounds
d. 801.77 pounds
e. 751.97 pounds

____ 12. A V8 car engine is coupled to a dynamometer and the horsepower $y$ is measured at different engine speeds $x$ (in thousands of revolutions per minute). The results are shown in the table below. Use the regression capabilities of a graphing utility to find a cubic model for the data. Round the numerical values in your answer to three decimal places, where applicable.

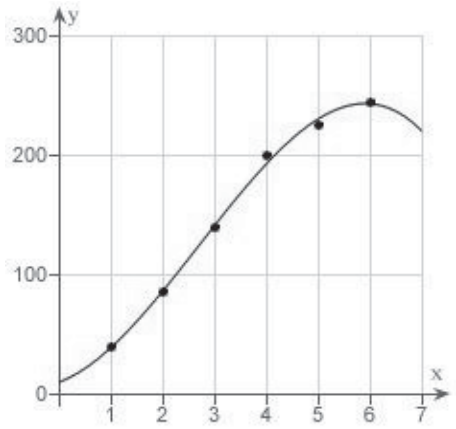
| $x$ | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| $y$ | 64 | 109 | 164 | 224 | 249 | 269 |

a. $y = -1.608x^3 - 14.583x^2 + 13.389x - 37$
b. $y = -1.706x^3 - 14.583x^2 - 16.389x + 34$
c. $y = 1.806x^3 + 11.583x^2 + 16.389x - 41$
d. $y = -1.806x^3 + 14.583x^2 + 16.389x + 34$
e. $y = 1.608x^3 + 11.583x^2 - 19.389x + 41$

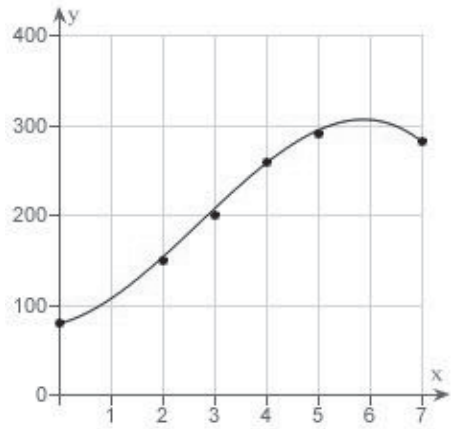
____ 13. A V8 car engine is coupled to a dynamometer and the horsepower $y$ is measured at different engine speeds $x$ (in thousands of revolutions per minute). The results are shown in the table below. Use a graphing utility to plot the data and graph the cubic model.

| $x$ | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| $y$ | 110 | 155 | 210 | 270 | 295 | 315 |

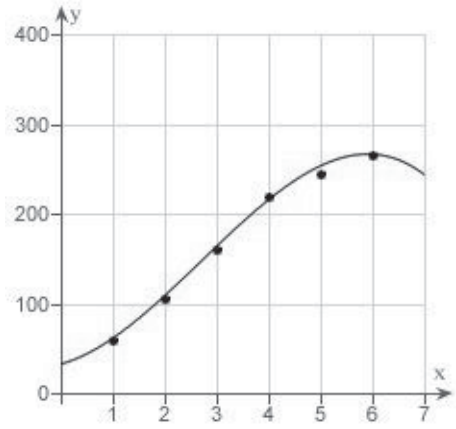
a.



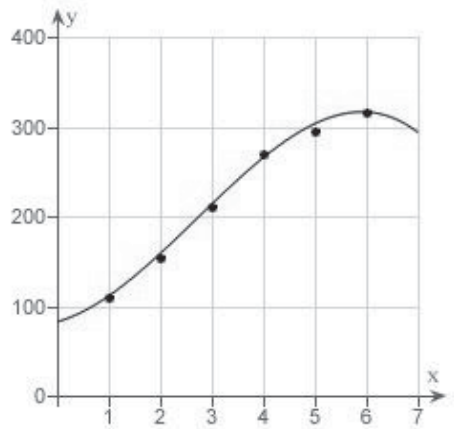

b.



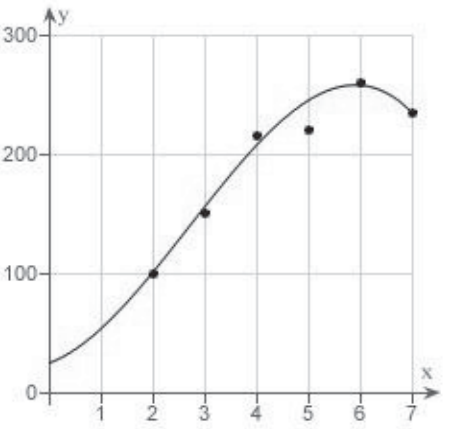

c.




d.




e.

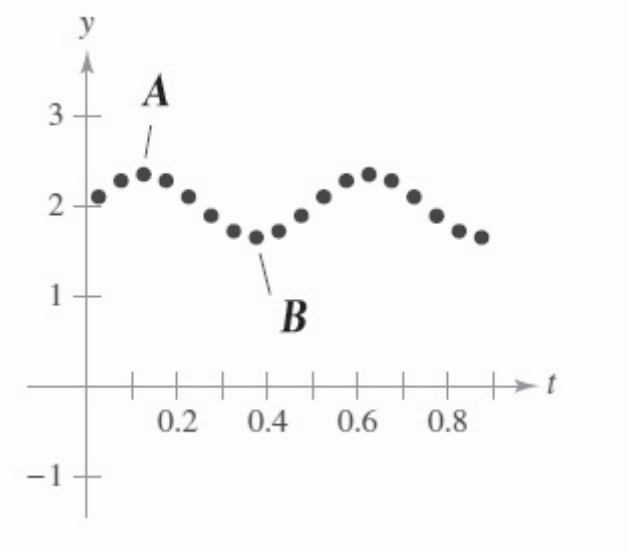


____ 14. A V8 car engine is coupled to a dynamometer and the horsepower $y$ is measured at different engine speeds $x$ (in thousands of revolutions per minute). The results are shown in the table below. Use the model $y = -1.806x^3 + 14.58x^2 + 16.4x + 30$ to approximate the horsepower when the engine is running at 5500 revolutions per minute. Round your answer to two decimal places.

| $x$ | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| $y$ | 60 | 105 | 160 | 220 | 245 | 265 |

a. 260.77 hp
b. 262.73 hp
c. 262.36 hp
d. 261.38 hp
e. 261.91 hp

____ 15. The motion of an oscillating weight suspended by a spring was measured by a motion detector. The data collected and the approximate maximum (positive and negative) displacements from equilibrium are shown in the figure. The displacement is measured in centimeters, and the time is measured in seconds. Take $A(0.133,2.49)$ and $B(0.343,1.78)$. Approximate the amplitude and period of the oscillations.




a. Amplitude = 0.335. Period = 4.3.
b. Amplitude = 0.71. Period = 2.1.
c. Amplitude = 0.355. Period = 4.2.
d. Amplitude = 4.2. Period = 0.355.
e. Amplitude = 2.1. Period = 0.71.

## P.4 Fitting Models to Data
## Answer Section

### MULTIPLE CHOICE

1. ANS: A PTS: 1 DIF: Easy REF: Section 0.4
OBJ: Identify the most appropriate function for a scatter plot MSC: Skill
2. ANS: D PTS: 1 DIF: Easy REF: Section 0.4
OBJ: Identify the most appropriate function for a scatter plot MSC: Skill
3. ANS: D PTS: 1 DIF: Easy REF: Section 0.4
OBJ: Write a linear model for data using the regression capabilities of a graphing utility
MSC: Application
4. ANS: D PTS: 1 DIF: Easy REF: Section 0.4
OBJ: Plot data points and the graph of a linear model MSC: Application
5. ANS: C PTS: 1 DIF: Easy REF: Section 0.4
OBJ: Evaluate linear models in applications MSC: Application
6. ANS: A PTS: 1 DIF: Easy REF: Section 0.4
OBJ: Write a linear model for data using the regression capabilities of a graphing utility
MSC: Application
7. ANS: C PTS: 1 DIF: Easy REF: Section 0.4
OBJ: Plot data points and the graph of a linear model MSC: Application
8. ANS: E PTS: 1 DIF: Easy REF: Section 0.4
OBJ: Evaluate linear models in applications MSC: Application
9. ANS: B PTS: 1 DIF: Med REF: Section 0.4
OBJ: Write a quadratic model for data using the regression capabilities of a graphing utility
MSC: Application
10. ANS: B PTS: 1 DIF: Med REF: Section 0.4
OBJ: Plot data points and the graph of a quadratic model MSC: Application
11. ANS: A PTS: 1 DIF: Med REF: Section 0.4
OBJ: Evaluate quadratic models in applications MSC: Application
12. ANS: D PTS: 1 DIF: Med REF: Section 0.4
OBJ: Evaluate cubic models in applications MSC: Application
13. ANS: D PTS: 1 DIF: Med REF: Section 0.4
OBJ: Plot data points and the graph of a cubic model MSC: Application
14. ANS: A PTS: 1 DIF: Med REF: Section 0.4
OBJ: Write a cubic model for data using the regression capabilities of a graphing utility
MSC: Application
15. ANS: C PTS: 1 DIF: Easy REF: Section 0.4
OBJ: Fit a trigonometric model to a real-life data set. MSC: Application

# 1.1 A Preview of Calculus

### Multiple Choice

*Identify the choice that best completes the statement or answers the question.*

____ 1. Decide whether the following problem can be solved using precalculus, or whether calculus is required. If the problem can be solved using precalculus, solve it. If the problem seems to require calculus, use a graphical or numerical approach to estimate the solution.

Find the distance traveled in 16 seconds by an object traveling at a constant velocity of 20 feet per second.

a. calculus, 320 ft
b. calculus, 340 ft
c. precalculus, 320 ft
d. calculus, 640 ft
e. precalculus, 640 ft

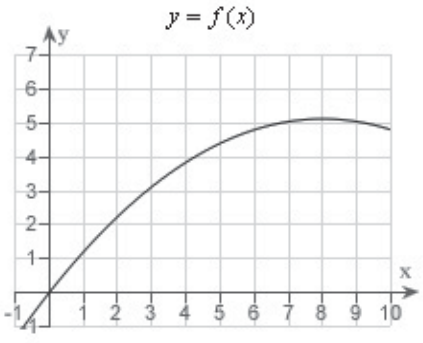
____ 2. Decide whether the following problem can be solved using precalculus, or whether calculus is required. If the problem can be solved using precalculus, solve it. If the problem seems to require calculus, use a graphical or numerical approach to estimate the solution.

Find the distance traveled in 20 seconds by an object moving with a velocity of $v(t) = 8 + 6\cos t$ feet per second.

a. calculus, 162.4485 ft
b. precalculus, 163.7985 ft
c. calculus, 165.4777 ft
d. precalculus, 165.4777 ft
e. precalculus, 162.4485 ft

____ 3. Decide whether the following problem can be solved using precalculus, or whether calculus is required. If the problem can be solved using precalculus, solve it. If the problem seems to require calculus, use a graphical or numerical approach to estimate the solution.

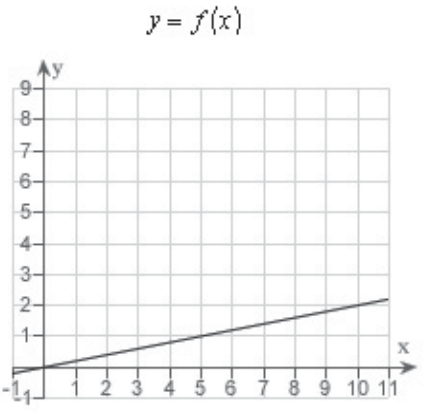
A cyclist is riding on a path whose elevation is modeled by the function $f(x) = 0.08\left(16x - x^2\right)$ where $x$ and $f(x)$ are measured in miles. Find the rate of change of elevation when $x = 4$.




a. precalculus, 0.08
b. calculus, 0.2
c. calculus, 0.64
d. calculus, 0.08
e. precalculus, 0.2

____ 4. Decide whether the following problem can be solved using precalculus, or whether calculus is required. If the problem can be solved using precalculus, solve it. If the problem seems to require calculus, use a graphical or numerical approach to estimate the solution.

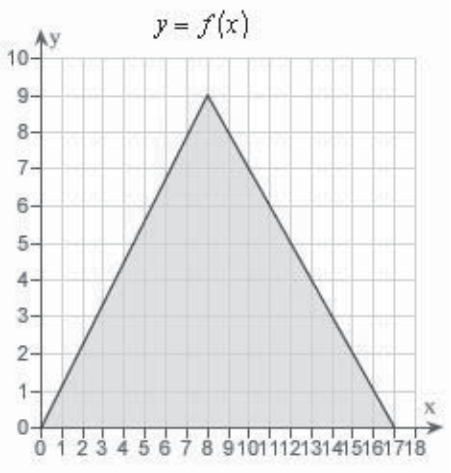
A cyclist is riding on a path whose elevation is modeled by the function $f(x) = 0.2x$ where $x$ and $f(x)$ are measured in miles. Find the rate of change of elevation when $x = 5$.




a. calculus, 2
b. precalculus, 0.2
c. calculus, 0.2
d. precalculus, 2
e. precalculus, 0.45

____ 5. Decide whether the following problem can be solved using precalculus, or whether calculus is required. If the problem can be solved using precalculus, solve it. If the problem seems to require calculus, use a graphical or numerical approach to estimate the solution.

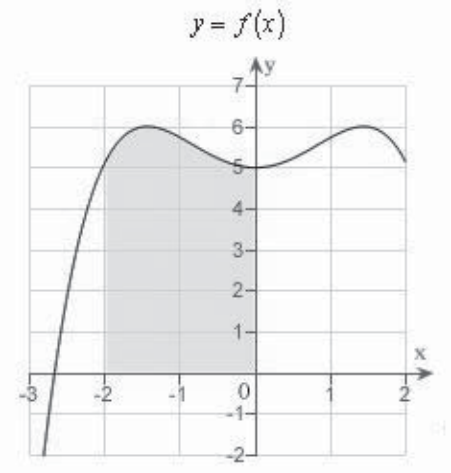
Find the area of the shaded region bounded by the triangle with vertices (0,0), (8,9), (17,0).




a. precalculus , 153
b. calculus , 229.5
c. precalculus , 76.5
d. precalculus , 229.5
e. calculus , 153

____ 6. Decide whether the following problem can be solved using precalculus, or whether calculus is required. If the problem can be solved using precalculus, solve it. If the problem seems to require calculus, use a graphical or numerical approach to estimate the solution.

Find the area of the shaded region.

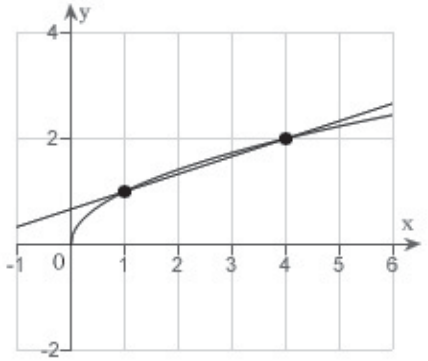



a. calculus , 11
b. precalculus , 11
c. precalculus , 13

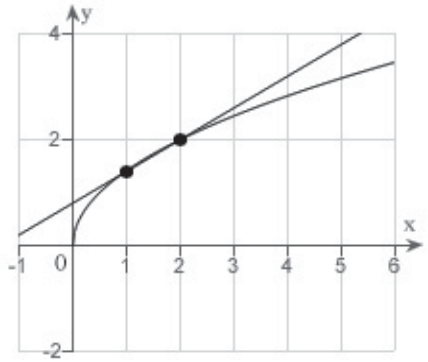
d. calculus , 16
e. precalculus , 16

____ 7. Consider the function $f(x) = \sqrt{x}$ and the point $P(4, 2)$ on the graph of *f*. Graph *f* and the secant line passing through $P(4, 2)$ and $Q\left(x, f(x)\right)$ for $x = 3$.

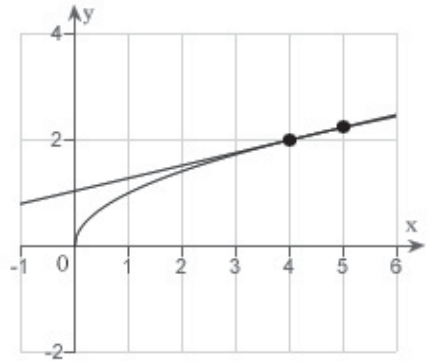
a.



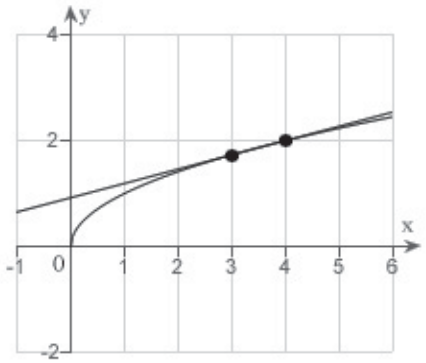

b.



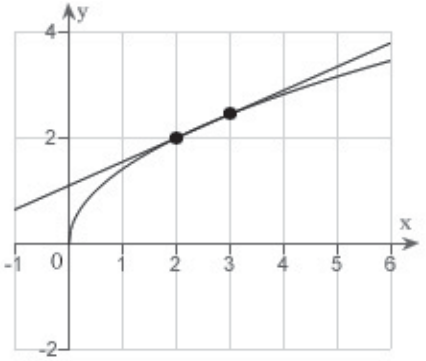

c.




d.




e.



____ 8. Consider the function $f(x) = \sqrt{x}$ and the point $P(81, 9)$ on the graph of *f*. Find the slope of the secant line passing through $P(81, 9)$ and $Q(x, f(x))$ for $x = 1$. Round your answer to four decimal places.

a. m=0.1000
b. m=0.0122
c. m=0.0122
d. m=0.3133
e. m=0.1000

____ 9. Consider the function $f(x) = \sqrt{x}$ and the point *P*(64,8) on the graph of *f*.

Consider the secant lines passing through *P*(64,8) and *Q*(*x, f*(*x*)) for *x* values of 61, 63, and 65. Find the slope of each secant line to four decimal places.

(Think about how you could use your results to estimate the slope of the tangent line of *f* at *P*(64,8), and how to improve your approximation of the slope.)

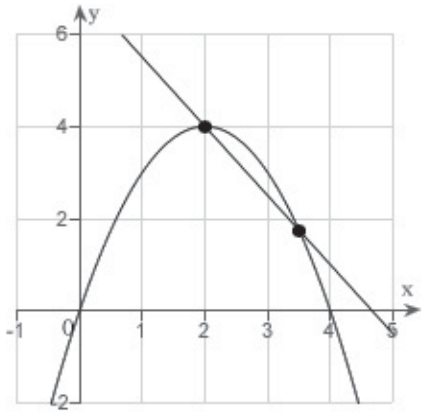
a. 0.0633 , –0.0627 , 0.0623
b. 0.0633 , 0.0627 , 0.0623
c. 0.0317 , 0.0314 , 0.0312
d. 0.0633 , –0.0627 , –0.0623
e. –0.0317 , –0.0314 , –0.0312

____ 10. Consider the function $f(x) = \sqrt{x}$ and the point $P(9, 3)$ on the graph of *f*. Estimate the slope *m* of the tangent line of *f* at $P(9, 3)$. Round your answer to four decimal places.

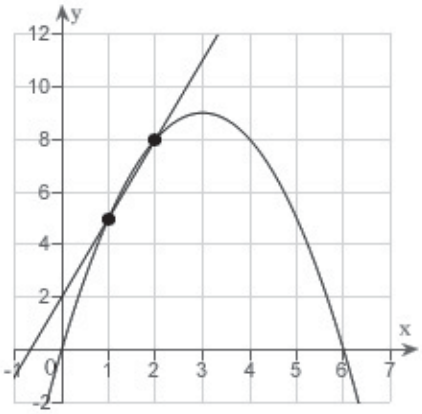
a. m=0.1667
b. m=0.0832
c. m=0.3800
d. m=0.0556
e. m=0.0833

____ 11. Consider the function $f(x) = 6x - x^2$ and the point $P(2, 8)$ on the graph of *f*. Graph *f* and the secant line passing through $P(2, 8)$ and $Q(x, f(x))$ for $x = 3$.

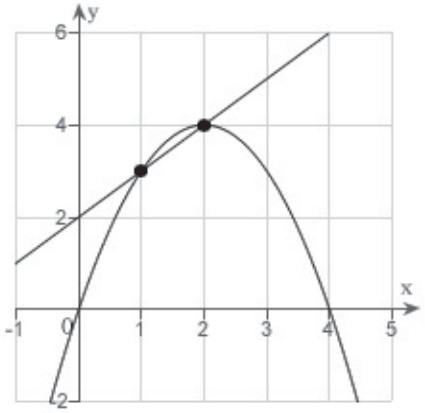
a.



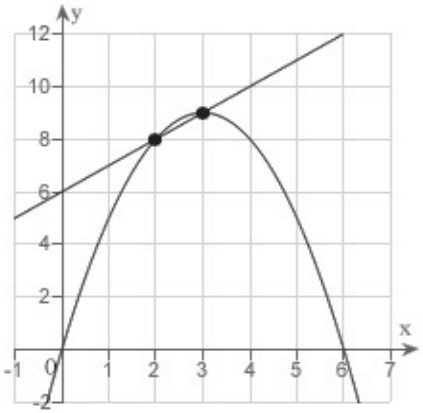

b.



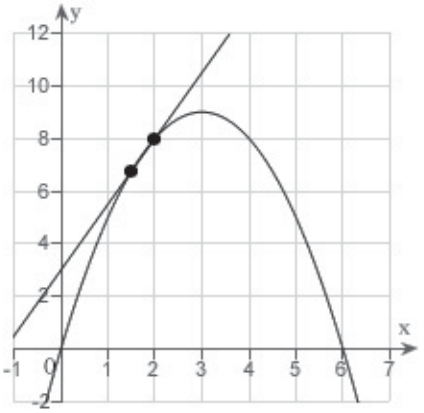

c.




d.




e.



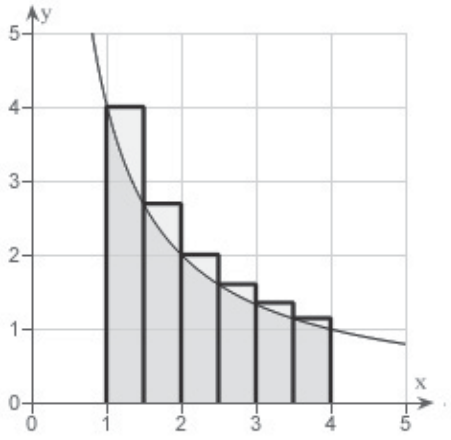
____ 12. Consider the function $f(x) = 11x - x^2$ and the point $P(4, 28)$ on the graph of *f*. Find the slope of the secant line passing through $P(4, 28)$ and $Q\left(x, f(x)\right)$ for $x = 5$. Round your answer to one decimal place.

a. 3.5
b. 2.0
c. 3.0
d. 4.5
e. 9.0

____ 13. Consider the function $f(x) = 8x - x^2$ and the point $P(3, 15)$ on the graph of *f*. Estimate the slope of the tangent line of *f* at $P(3, 15)$.

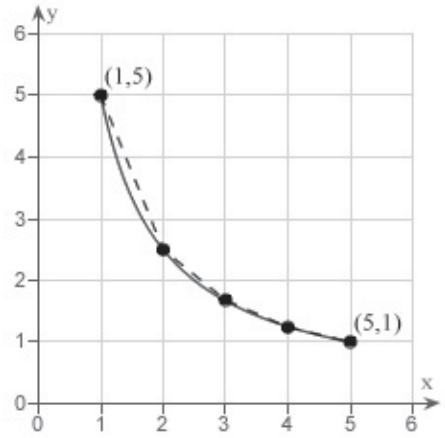
a. 10
b. 3
c. 8
d. 2
e. 9

____ 14. Use the rectangles in the graph given below to approximate the area of the region bounded by $y = 4 / x$, $y = 0$, $x = 1$, and $x = 4$ Round your answer to three decimal places.




a. 2.481 units$^2$
b. 6.371 units$^2$
c. 3.585 units$^2$
d. 6.872 units$^2$
e. 6.903 units$^2$

____ 15. Consider the length of the graph of $f(x) = 5/x$ from $(1, 5)$ to $(5, 1)$ Approximate the length of the curve by finding the sum of the lengths of four line segments, as shown in following figure. Round your answer to two decimal places.




a. 6.11
b. 8.12
c. 5.66
d. 8.49
e. 7.11

# 1.1 A Preview of Calculus
# Answer Section

## MULTIPLE CHOICE

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. | ANS: | C | PTS: | 1 | DIF: | Easy | REF: | Section 1.1 |
| OBJ: | Recognize problems requiring precalculus and find the solution | | | | | | MSC: | Skill |
| 2. | ANS: | C | PTS: | 1 | DIF: | Med | REF: | Section 1.1 |
| OBJ: | Recognize problems requiring calculus and estimate solutions | | | | | | MSC: | Skill |
| 3. | ANS: | C | PTS: | 1 | DIF: | Med | REF: | Section 1.1 |
| OBJ: | Recognize problems requiring calculus and estimate solutions | | | | | | MSC: | Skill |
| 4. | ANS: | B | PTS: | 1 | DIF: | Easy | REF: | Section 1.1 |
| OBJ: | Recognize problems requiring precalculus and find the solution | | | | | | MSC: | Skill |
| 5. | ANS: | C | PTS: | 1 | DIF: | Easy | REF: | Section 1.1 |
| OBJ: | Recognize problems requiring precalculus and find the solution | | | | | | MSC: | Skill |
| 6. | ANS: | A | PTS: | 1 | DIF: | Med | REF: | Section 1.1 |
| OBJ: | Recognize problems requiring calculus and estimate solution | | | | | | MSC: | Skill |
| 7. | ANS: | D | PTS: | 1 | DIF: | Easy | REF: | Section 1.1 |
| OBJ: | Graph a function and the secant line passing through given points | | | | | | MSC: | Skill |
| 8. | ANS: | A | PTS: | 1 | DIF: | Easy | REF: | Section 1.1 |
| OBJ: | Calculate the slope of a secant line passing through given points | | | | | | MSC: | Skill |
| 9. | ANS: | D | PTS: | 1 | DIF: | Med | REF: | Section 1.1 |
| OBJ: | Calculate the slopes of secant lines | | | | | | MSC: | Skill |
| 10. | ANS: | A | PTS: | 1 | DIF: | Med | REF: | Section 1.1 |
| OBJ: | Estimate the slope of a tangent line | | | | | | MSC: | Skill |
| 11. | ANS: | D | PTS: | 1 | DIF: | Easy | REF: | Section 1.1 |
| OBJ: | Graph a function and the secant line passing through given points | | | | | | MSC: | Skill |
| 12. | ANS: | B | PTS: | 1 | DIF: | Easy | REF: | Section 1.1 |
| OBJ: | Calculate the slope of a secant line passing through given points | | | | | | MSC: | Skill |
| 13. | ANS: | D | PTS: | 1 | DIF: | Med | REF: | Section 1.1 |
| OBJ: | Calculate the slope of secant line passing through the given points | | | | | | MSC: | Skill |
| 14. | ANS: | B | PTS: | 1 | DIF: | Med | REF: | Section 1.1 |
| OBJ: | Estimate the area of a region using rectangles | | | | | | MSC: | Skill |
| 15. | ANS: | A | PTS: | 1 | DIF: | Med | REF: | Section 1.1 |
| OBJ: | Estimate the length of the curve using a piecewise linear function | | | | | | MSC: | Skill |

## 1.2 Finding Limits Graphically and Numerically

### Multiple Choice

*Identify the choice that best completes the statement or answers the question.*

____ 1. Complete the table and use the result to estimate the limit.

$$\lim_{x \to 3} \frac{x-3}{x^2-16x+39}$$

| $x$ | 2.9 | 2.99 | 2.999 | 3.001 | 3.01 | 3.1 |
|---|---|---|---|---|---|---|
| $f(x)$ | | | | | | |

a. 0.525000
b. 0.275000
c. –0.100000
d. 0.400000
e. –0.475000

____ 2. Complete the table and use the result to estimate the limit.

$$\lim_{x \to 7} \frac{\frac{1}{x-3} - \frac{1}{4}}{x-7}$$

| $x$ | 6.9 | 6.99 | 6.999 | 7.001 | 7.01 | 7.1 |
|---|---|---|---|---|---|---|
| $f(x)$ | | | | | | |

a. –0.062500
b. 0.067500
c. –0.192500
d. 0.047500
e. –0.172500

____ 3. Complete the table and use the result to estimate the limit.

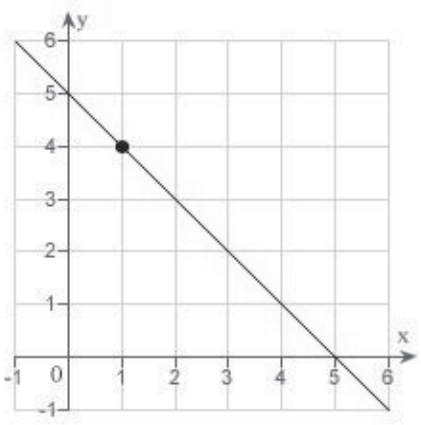
$$\lim_{x \to 0} \frac{\cos(3x)-1}{3x}$$

| $x$ | –0.1 | –0.01 | –0.001 | 0.001 | 0.01 | 0.1 |
|---|---|---|---|---|---|---|
| $f(x)$ | | | | | | |

a. $-1$
b. $-0.5$
c. 0
d. 0.5
e. 1

____ 4. Determine the following limit. (Hint: Use the graph to calculate the limit.)

$$\lim_{x \to 1} (5 - x)$$

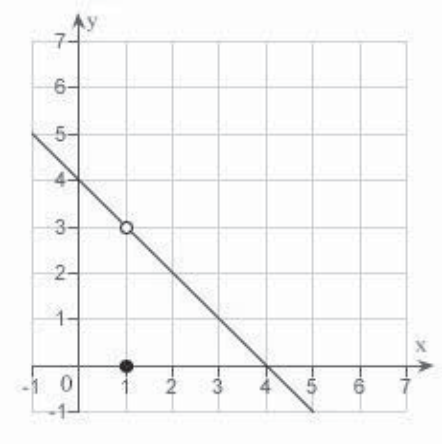



a. 6
b. 1
c. 5
d. 4
e. does not exist

____ 5. Let $f(x) = \begin{cases} 4 - x, & x \neq 1 \\ 0, & x = 1 \end{cases}$.

Determine the following limit. (Hint: Use the graph to calculate the limit.)

$$\lim_{x \to 1} f(x)$$

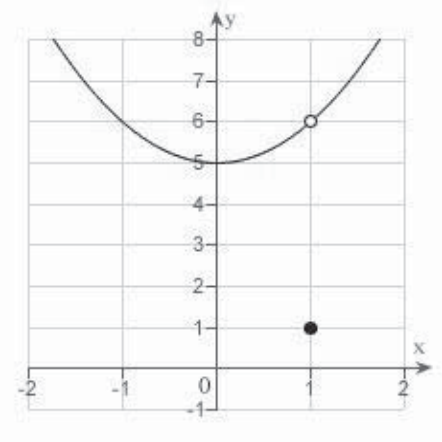



a. 5
b. 4
c. 3
d. 0
e. does not exist

____ 6. Let $f(x) = \begin{cases} x^2 + 5, & x \neq 1 \\ 1, & x = 1 \end{cases}$.

Determine the following limit. (Hint: Use the graph to calculate the limit.)

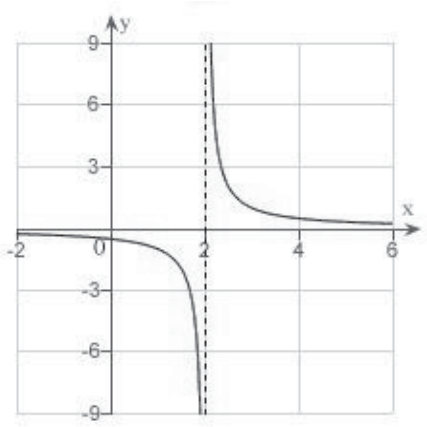
$\lim_{x \to 1} f(x)$




a. 6
b. 25
c. 1
d. 5
e. does not exist.

____ 7. Determine the following limit. (Hint: Use the graph to calculate the limit.)

$$\lim_{x \to 2} \frac{1}{x - 2}$$




a. –2
b. 0
c. –4
d. 2
e. does not exist

____ 8. A ring has a inner circumference of 10 centimeters. What is the radius of the ring? Round your answer to four decimal places.

a. 0.7958 centimeter
b. 3.1831 centimeters
c. 1.5915 centimeters
d. 1.7841 centimeters
e. 10.1321 centimeters

____ 9. A ring has a inner circumference of 9 centimeters. If the ring's inner circumference can vary between 8 centimeters and 10 centimeters how can the radius vary? Round your answer to five decimal places.

a. Radius can vary between 6.48456 centimeters and 10.13212 centimeters.
b. Radius can vary between 1.59577 centimeters and 1.78412 centimeters.
c. Radius can vary between 1.27324 centimeters and 1.59155 centimeters.
d. Radius can vary between 2.54648 centimeters and 3.18310 centimeters.
e. Radius can vary between 0.43239 centimeter and 2.43239 centimeters.

____ 10. A sphere has a volume of 4.76 cubic inches. What is the radius of the sphere? Round your answer to four decimal places.

a. 1.0435 inches
b. 1.6565 inches
c. 1.0660 inches
d. 2.1320 inches
e. 1.9335 inches

____ 11. A sphere has a volume of 4.44 cubic inches. If the sphere's volume can vary between 3.64 cubic inches and 5.04 cubic inches , how can the radius vary? Round your answer to five decimal places.

a. Radius can vary between 0.93219 inch and 1.09691 inches.
b. Radius can vary between 0.21960 inch and 1.61960 inches.
c. Radius can vary between 1.69081 inches and 1.98957 inches.
d. Radius can vary between 1.51481 inches and 1.68837 inches.
e. Radius can vary between 0.95427 inch and 1.06361 inches.

____ 12. Find the limit L.

$\lim_{x \to 7} (x + 2)$

a. L = 9
b. L = 2
c. L = 7
d. L = 16
e. none of the above

____ 13. Find the limit L.

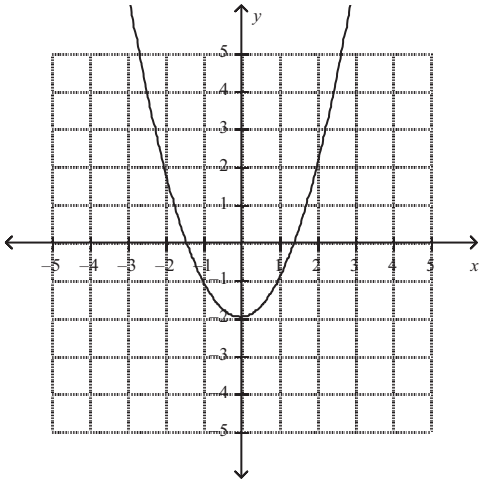
$\lim_{x \to -2} (x^2 + 4x)$

a. L = 12
b. L = 6
c. L = 2
d. L = –4
e. none of the above

____ 14. What is the limit of $f(x) = 4$ as $x$ approaches $\pi$?

a. $\lim_{x \to \pi} (4) = \pi$
b. $\lim_{x \to \pi} (4) = 4$
c. $\lim_{x \to \pi} (4) = \frac{\pi}{4}$
d. $\lim_{x \to \pi} (4) = 4\pi$
e. none of the above

_____ 15. The graph of $f(x) = x^2 - 2$ is shown in the figure. Find $\delta$ such that if $0 < |x - 3| < \delta$, then $|f(x) - 7| < 0.2$.




a. $\delta = \sqrt{9.2} - 3$
b. $\delta = \sqrt{9.2} + 3$
c. $\delta = \sqrt{7} - 3$
d. $\delta = \sqrt{7} - 2$
e. None of the above

## 1.2 Finding Limits Graphically and Numerically
## Answer Section

### MULTIPLE CHOICE

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. | ANS: | C | PTS: | 1 | DIF: | Med | REF: | Section 1.2 |
| OBJ: | Estimate a limit from a table of values | | | | | | MSC: | Skill |
| 2. | ANS: | A | PTS: | 1 | DIF: | Med | REF: | Section 1.2 |
| OBJ: | Estimate a limit from a table of values | | | | | | MSC: | Skill |
| 3. | ANS: | C | PTS: | 1 | DIF: | Med | REF: | Section 1.2 |
| OBJ: | Estimate a limit from a table of values | | | | | | MSC: | Skill |
| 4. | ANS: | D | PTS: | 1 | DIF: | Easy | REF: | Section 1.2 |
| OBJ: | Estimate the limit of a function from its graph | | | | | | MSC: | Skill |
| 5. | ANS: | C | PTS: | 1 | DIF: | Med | REF: | Section 1.2 |
| OBJ: | Estimate the limit of a function from its graph | | | | | | MSC: | Skill |
| 6. | ANS: | A | PTS: | 1 | DIF: | Med | REF: | Section 1.2 |
| OBJ: | Estimate the limit of a function from its graph | | | | | | MSC: | Skill |
| 7. | ANS: | E | PTS: | 1 | DIF: | Med | REF: | Section 1.2 |
| OBJ: | Estimate the limit of a function from its graph | | | | | | MSC: | Skill |
| 8. | ANS: | C | PTS: | 1 | DIF: | Easy | REF: | Section 1.2 |
| OBJ: | Solve a linear equation in applications | | | | | | MSC: | Application |
| 9. | ANS: | C | PTS: | 1 | DIF: | Med | REF: | Section 1.2 |
| OBJ: | Solve a linear equation in applications | | | | | | MSC: | Application |
| 10. | ANS: | A | PTS: | 1 | DIF: | Easy | REF: | Section 1.2 |
| OBJ: | Solve a cubic equation in applications | | | | | | MSC: | Application |
| 11. | ANS: | E | PTS: | 1 | DIF: | Med | REF: | Section 1.2 |
| OBJ: | Solve a linear equation in applications | | | | | | MSC: | Application |
| 12. | ANS: | A | PTS: | 1 | DIF: | Easy | REF: | Section 1.2 |
| OBJ: | Estimate a limit using a numerical or graphical approach | | | | | | MSC: | Skill |
| 13. | ANS: | D | PTS: | 1 | DIF: | Easy | REF: | Section 1.2 |
| OBJ: | Estimate a limit using a numerical or graphical approach | | | | | | MSC: | Skill |
| 14. | ANS: | B | PTS: | 1 | DIF: | Easy | REF: | Section 1.2 |
| OBJ: | Estimate a limit using a numerical or graphical approach | | | | | | MSC: | Skill |
| 15. | ANS: | A | PTS: | 1 | DIF: | Med | REF: | Section 1.2 |
| OBJ: | Estimate a limit using a numerical or graphical approach | | | | | | MSC: | Skill |

## 1.3 Evaluating Limits Analytically

### Multiple Choice

*Identify the choice that best completes the statement or answers the question.*

____ 1. Find the limit.

$$\lim_{x \to -4} 9x^2 + 36x$$

a. 108
b. −108
c. 288
d. −288
e. 0

____ 2. Find the limit.

$$\lim_{x \to 6} \frac{x}{x^2 + 8}$$

a. $\frac{1}{14}$
b. $\frac{1}{10}$
c. $\frac{3}{22}$
d. $\frac{3}{7}$
e. $\frac{3}{10}$

____ 3. Find the limit.

$$\lim_{x \to 4} \frac{\sqrt{x+5}}{x-1}$$

a. 3
b. −1
c. –3
d. 1
e. 9

____ 4. Let $f(x) = 4x - 2$ and $g(x) = x^3$. Find the limit.

$$\lim_{x \to 1} g(f(x))$$

a. 2
b. 1
c. 8
d. –8
e. –4

____ 5. Let $f(x) = 3 + 2x^2$ and $g(x) = \sqrt{x+3}$. Find the limit.

$$\lim_{x \to 2} g(f(x))$$

a. $\sqrt{6}$
b. $\sqrt{14}$
c. $\sqrt{11}$
d. $\sqrt{10}$
e. $\sqrt{2}$

____ 6. Let $f(x) = x^2 - x - 5$ and $g(x) = \sqrt[3]{x+14}$. Find the limits.

$$\lim_{x \to 3} g(f(x))$$

a. $-\sqrt[3]{1}$
b. $\sqrt[3]{29}$
c. $-\sqrt[3]{15}$
d. $\sqrt[3]{15}$
e. $\sqrt[3]{1}$

____ 7. Find the limit.

$$\lim_{x \to \pi} \tan\left(\frac{x}{3}\right)$$

a. $\dfrac{-1}{\sqrt{3}}$
b. $\sqrt{3}$
c. $-\sqrt{3}$
d. $\dfrac{1}{\sqrt{3}}$
e. does not exixt

____ 8. Find the limit.

$$\lim_{x \to 2} \cos \frac{\pi x}{3}$$

a. $\frac{1}{2}$
b. $-\frac{1}{2}$
c. $-\frac{\sqrt{3}}{2}$
d. $\frac{\sqrt{3}}{2}$
e. 0

____ 9. Find the limit.

$$\lim_{x \to 5} \cos\left(\frac{\pi x}{6}\right)$$

a. $-\frac{1}{2}$
b. 0
c. $\frac{1}{2}$
d. $-\frac{\sqrt{3}}{2}$
e. $\frac{\sqrt{3}}{2}$

____ 10. Find the limit.

$$\lim_{x \to \frac{3\pi}{4}} \sin x$$

a. $\frac{\sqrt{3}}{2}$
b. $-\frac{\sqrt{2}}{2}$
c. $-\frac{1}{2}$
d. $\frac{\sqrt{2}}{2}$
e. does not exist

____ 11. Suppose that $\lim_{x \to c} f(x) = -13$ and $\lim_{x \to c} g(x) = -10$. Find the following limit.

$$\lim_{x \to c} \left[ f(x) + g(x) \right]$$

a. 0
b. –10
c. –3
d. –23
e. 130

____ 12. Suppose that $\lim_{x \to c} f(x) = -11$ and $\lim_{x \to c} g(x) = -3$. Find the following limit.

$$\lim_{x \to c} \left[ f(x) - g(x) \right]$$

a. –11
b. –8
c. 33
d. –14
e. 0

____ 13. Suppose that $\lim_{x \to c} f(x) = -15$ and $\lim_{x \to c} g(x) = -10$. Find the following limit.

$$\lim_{x \to c} \left[ f(x)g(x) \right]$$

a. 10
b. –5
c. –25
d. –15
e. 150

____ 14. Suppose that $\lim_{x \to c} f(x) = 7$ and $\lim_{x \to c} g(x) = 3$. Find the following limit.

$$\lim_{x \to c} \frac{f(x)}{g(x)}$$

a. 21
b. $\frac{3}{7}$
c. –21
d. $\frac{7}{3}$
e. does not exist

____ 15. Suppose that $\lim_{x \to c} f(x) = 5$. Find the following limit.

$$\lim_{x \to c} \left[ f(x)^3 \right]$$

a. 2
b. 125
c. 8
d. 0
e. 15

____ 16. Suppose that $\lim_{x \to c} f(x) = -5$. Find the following limit.

$$\lim_{x \to c} 3f(x)$$

a. –5
b. 15
c. –15
d. $3c$
e. 3

____ 17. Find the following limit (if it exists). Write a simpler function that agrees with the given function at all but one point.

$$\lim_{x \to -4} \frac{8x^2 + 40x + 32}{x + 4}$$

a. 40
b. –24
c. 24
d. –40
e. does not exist

____ 18. Find the limit (if it exists).

$$\lim_{x \to -8} \frac{x + 8}{x^2 - 64}$$

a. $-\frac{1}{16}$
b. $-\frac{1}{32}$
c. –32
d. –8
e. $\frac{1}{16}$

____ 19. Find the limit (if it exists).

$$\lim_{x \to 5} \frac{\sqrt{x+4} - 3}{x - 5}$$

a. 6
b. 1
c. 0
d. $\frac{1}{6}$
e. Limit does not exist.

____ 20. Find the limit (if it exists).

$$\lim_{\Delta x \to 0} \frac{(x + \Delta x)^2 - 9(x + \Delta x) + 2 - \left(x^2 - 9x + 2\right)}{\Delta x}$$

a. $\frac{1}{3}x^3 - \frac{9}{2}x^2 + 2x$
b. $2x - 9$
c. $x^3 - 9x^2 + 2x$
d. $x^2 - 9x + 2$
e. does not exist

____ 21. Determine the limit (if it exists).

$$\lim_{x \to 0} \frac{12(1 - \cos x)}{x^2}$$

a. 6
b. 48
c. 10
d. 24
e. does not exist

____ 22. Determine the limit (if it exists).

$$\lim_{x \to 0} \frac{\sin x(1 - \cos x)}{2x^8}$$

a. 8
b. 1
c. 0
d. 2
e. does not exist

____ 23. Determine the limit (if it exists).

$$\lim_{x \to 0} \frac{\sin^4 x}{x^3}$$

a. 1
b. 0
c. 2
d. $\infty$
e. does not exist

____ 24. Find $\lim_{\Delta x \to 0} \frac{f(x + \Delta x) - f(x)}{\Delta x}$ where $f(x) = 4x - 3$.

a. 1
b. 4
c. –3
d. 0
e. Limit does not exist.

## 1.3 Evaluating Limits Analytically
## Answer Section

1. ANS: E PTS: 1 DIF: Easy REF: Section 1.3
OBJ: Evaluate a limit using properties of limits MSC: Skill
2. ANS: C PTS: 1 DIF: Easy REF: Section 1.3
OBJ: Evaluate a limit using properties of limits MSC: Skill
3. ANS: D PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate a limit using properties of limits MSC: Skill
4. ANS: C PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate the limit of composite functions MSC: Skill
5. ANS: B PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate the limit of composite functions MSC: Skill
6. ANS: D PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate the limit of composite functions MSC: Skill
7. ANS: B PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate the limit of the function MSC: Skill
8. ANS: B PTS: 1 DIF: Easy REF: Section 1.3
OBJ: Evaluate a limit using properties of limits MSC: Skill
9. ANS: D PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate a limit using properties of limits MSC: Skill
10. ANS: D PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate a limit using properties of limits MSC: Skill
11. ANS: D PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate the limit of a function using properties of limits MSC: Skill
12. ANS: B PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate the limit of a function using properties of limits MSC: Skill
13. ANS: E PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate the limit of a function using properties of limits MSC: Skill
14. ANS: D PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate the limit of a function using properties of limits MSC: Skill
15. ANS: B PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate the limit of a function using properties of limits MSC: Skill
16. ANS: C PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate the limit of a function using properties of limits MSC: Skill
17. ANS: B PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate the limit of the function and simplify it to an identical function except at the discontinuity point MSC: Skill
18. ANS: A PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate the limit of a function analytically MSC: Skill
19. ANS: D PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate the limit of a function analytically MSC: Skill
20. ANS: B PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate the limit of a function analytically MSC: Skill
21. ANS: A PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate the limit of a function analytically MSC: Skill

22. ANS: E PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate the limit of a function analytically MSC: Skill
23. ANS: B PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate the limit of a function analytically MSC: Skill
24. ANS: B PTS: 1 DIF: Med REF: Section 1.3
OBJ: Evaluate the limit of a difference quotient MSC: Skill

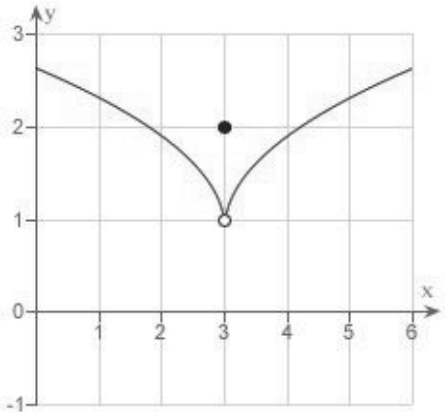
## 1.4 Continuity and One-Sided Limits

### Multiple Choice

*Identify the choice that best completes the statement or answers the question.*

____ 1. Use the graph as shown to determine the following limits, and discuss the continuity of the function at $x = 3$.

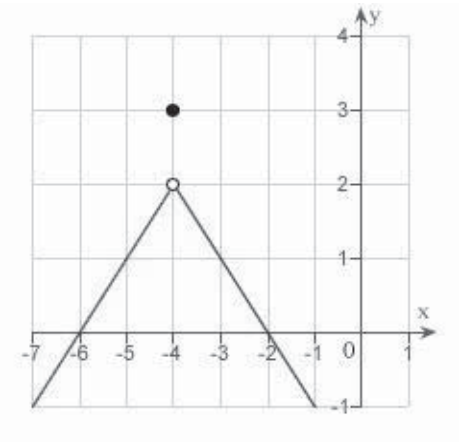
(i) $\lim_{x \to 3^+} f(x)$ (ii) $\lim_{x \to 3^-} f(x)$ (iii) $\lim_{x \to 3} f(x)$




a. 1 , 1 , 1 , not continuous
b. 2 , 2 , 2 , continuous
c. 4 , 4 , 4 , not continuous
d. 2 , 2 , 2 , not continuous
e. 1 , 1 , 1 , continuous

____ 2. Use the graph as shown to determine the following limits, and discuss the continuity of the function at $x = -4$.

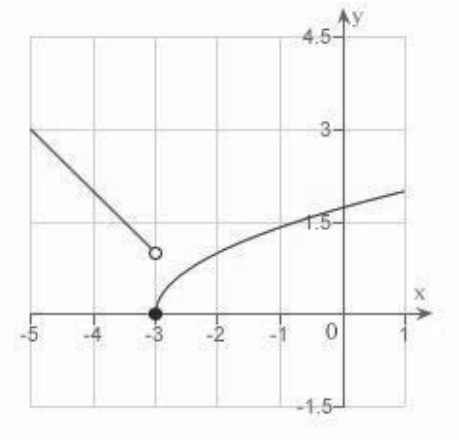
(i) $\lim_{x \to -4^+} f(x)$ (ii) $\lim_{x \to -4^-} f(x)$ (iii) $\lim_{x \to -4} f(x)$




a. 3, 3, 3, continuous
b. 2, 2, 2, not continuous
c. 3, 3, 3, not continuous
d. $-4, -4, -4$, continuous
e. 2, 2, 2, continuous

____ 3. Use the graph to determine the following limits, and discuss the continuity of the function at $x = -3$.

(i) $\lim_{x \to -3^+} f(x)$ (ii) $\lim_{x \to -3^-} f(x)$ (iii) $\lim_{x \to -3} f(x)$




a. 1, $-1$, does not exist, not continuous
b. 1, 0, does not exist, not continuous
c. 0, 1, does not exist, not continuous
d. $-3$, 0, does not exist, not continuous
e. 0, 1, 0, continuous

____ 4. Find the limit (if it exists).

$$\lim_{x \to 11^+} \frac{11 - x}{x^2 - 121}$$

a. $\frac{1}{22}$
b. 0
c. Limit does not exist.
d. $-\frac{1}{22}$
e. $\frac{1}{242}$

____ 5. Find the limit (if it exists).

$$\lim_{x \to 36^-} \frac{\sqrt{x} - 6}{x - 36}$$

a. 0
b. $-\frac{1}{12}$
c. $\frac{1}{72}$
d. $\frac{1}{12}$
e. Limit does not exist.

____ 6. Find the limit (if it exists).

$$\lim_{x \to 1^-} f(x), \text{ where } f(x) = \begin{cases} x^3 + 10, & x < 1 \\ x + 10, & x \geq 1 \end{cases}$$

a. Limit does not exist.
b. 0
c. 10
d. 11
e. 30

____ 7. Find the limit (if it exists). Note that $f(x) = \left[\,|x|\,\right]$ represents the greatest integer function.

$$\lim_{x \to -6^+} \left(-3\left[\,|x|\,\right] - 8\right)$$

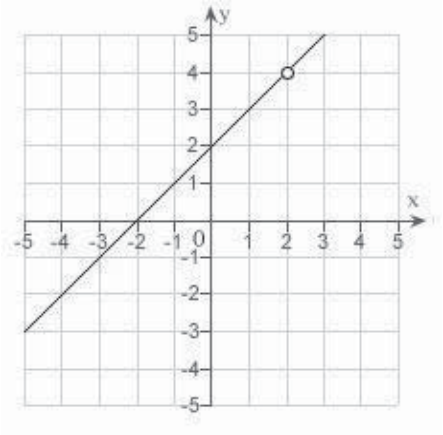
a. 13
b. $-10$
c. 10
d. $-13$
e. does not exist

____ 8. Find the limit (if it exists). Note that $f(x) = \left[\,|x|\,\right]$ represents the greatest integer function.

$$\lim_{x \to 5^+} \left(2x - \left[\,|x|\,\right]\right)$$

a. 6
b. Limit does not exist.
c. 5
d. 0
e. 4

____ 9. Discuss the continuity of the function $f(x) = \dfrac{x^2 - 4}{x - 2}$.




a. $f(x)$ is discontinuous at $x = -2$.
b. $f(x)$ is discontinuous at $x = -2, 2$.
c. $f(x)$ is discontinuous at $x = 2$.
d. $f(x)$ is continuous for all real $x$.
e. $f(x)$ is continuous at $x = 4$.

____ 10. Find the $x$-values (if any) at which the function $f(x) = 13x^2 - 15x - 15$ is not continuous. Which of the discontinuities are removable?

a. $x = 4$, removable
b. $x = 0$, removable
c. $x = \frac{15}{26}$, not removable.
d. continuous everywhere
e. $x = \frac{15}{26}$, removable.

____ 11. Find the $x$-values (if any) at which $f(x) = \frac{x}{x^2 - 2x}$ is not continuous.

a. $f(x)$ is not continuous at $x = 0$ and $f(x)$ has a removable discontinuity at $x = 0$.
b. $f(x)$ is not continuous at $x = 0, 2$ and both the discontinuities are nonremovable.
c. $f(x)$ is not continuous at $x = 2$ and $f(x)$ has a removable discontinuity at $x = 2$.
d. $f(x)$ is not continuous at $x = 0, 2$ and $f(x)$ has a removable discontinuity at $x = 0$.
e. $f(x)$ is continuous for all real $x$.

____ 12. Find the $x$-values (if any) at which the function $f(x) = \frac{x}{x^2 - 100}$ is not continuous. Which of the discontinuities are removable?

a. 10 and -10, removable
b. discontinuous everywhere
c. continuous everywhere
d. 10 and -10, not removable
e. 0, removable

____ 13. Find the $x$-values (if any) at which the function $f(x) = \frac{x+2}{x^2 + 6x + 8}$ is not continuous. Which of the discontinuities are removable?

a. no points of discontinuity
b. $x = -2$ (not removable), $x = -4$ (removable)
c. $x = -2$ ( removable), $x = -4$ (not removable)
d. no points of continuity
e. $x = -2$ (not removable), $x = -4$ (not removable)

____ 14. Find the $x$-values (if any) at which $f(x) = \frac{|x-3|}{x-3}$ is not continuous.

a. $f(x)$ is not continuous at $x = 3$ and the discontinuity is nonremovable.
b. $f(x)$ is not continuous at $x = 0$ and the discontinuity is removable.
c. $f(x)$ is continuous for all real $x$.
d. $f(x)$ is not continuous at $x = 3$ and the discontinuity is removable.
e. $f(x)$ is not continuous at $x = 0, -3$ and $x = 0$ is a removable discontinuity.

____ 15. Find the constant $a$ such that the function

$$f(x) = \begin{cases} -4 \cdot \dfrac{\sin x}{x}, & x < 0 \\ a + 7x, & x \geq 0 \end{cases}$$

is continuous on the entire real line.

a. 1
b. $-7$
c. 7
d. 4
e. $-4$

____ 16. Find the constants $a$ and $b$ such that the function

$$f(x) = \begin{cases} 6, & x \leq -5 \\ ax + b, & -5 < x < 1 \\ -6, & x \geq 1 \end{cases}$$

is continuous on the entire real line.

a. $a = 2, b = 0$
b. $a = 2, b = -4$
c. $a = -2, b = -4$
d. $a = -2, b = 4$
e. $a = 2, b = 4$

____ 17. Find the value of $c$ guaranteed by the Intermediate Value Theorem.

$$f(x) = x^2 - 2x + 8, [2, 6], f(c) = 11$$

a. 0
b. 3
c. 5
d. 1
e. 4

____ 18. Find the value of $c$ guaranteed by the Intermediate Value Theorem.

$$f(x) = \frac{x^2 - 5x}{x - 3}, \left[\frac{9}{2}, 18\right], f(c) = 6$$

a. 11
b. 2
c. 1
d. 9
e. 10

____ 19. A long distance phone service charges $\$0.35$ for the first $10$ minutes and $\$0.1$ for each additional minute or fraction thereof. Use the greatest integer function to write the cost $C$ of a call in terms of time $t$ (in minutes).

a. $$C = \begin{cases} 0.35 & 0 < t \le 10 \\ 0.35 + 0.1\left[\left|t - 10\right|\right] & t > 10, t \text{ is not an integer} \\ 0.35 + 0.1(t - 9) & t > 10, t \text{ is an integer} \end{cases}$$

b. $$C = \begin{cases} 0.35 & 0 < t \le 10 \\ 0.35 + 0.1(t - 10) & t > 10 \end{cases}$$

c. $$C = \begin{cases} 0.35 & 0 < t \le 10 \\ 0.35 + 0.1\left[\left|t - 9\right|\right] & t > 10 \end{cases}$$

d. $$C = \begin{cases} 0.35 & 0 < t \le 10 \\ 0.35 + 0.1\left[\left|t - 10\right|\right] & t > 10 \end{cases}$$

e. $$C = \begin{cases} 0.35 & 0 < t \le 10 \\ 0.35 + 0.1\left[\left|t - 9\right|\right] & t > 10, t \text{ is not an integer} \\ 0.35 + 0.1(t - 10) & t > 10, t \text{ is an integer} \end{cases}$$

____ 20. Find all values of $c$ such that $f$ is continuous on $\left(-\infty, \infty\right)$.

$$f(x) = \begin{cases} 4 - x^2, & x \le c \\ x, & x > c \end{cases}$$

a. $c = 3$

b. $c = 0$

c. $\dfrac{-1 + \sqrt{17}}{2}$

d. $\dfrac{1 + \sqrt{17}}{2}, \dfrac{1 - \sqrt{17}}{2}$

e. $\dfrac{-1 + \sqrt{17}}{2}, \dfrac{-1 - \sqrt{17}}{2}$

## 1.4 Continuity and One-Sided Limits
## Answer Section

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. | ANS: | A | PTS: | 1 | DIF: | Med | REF: | Section 1.4 |
| OBJ: | Estimate a limit and points of discontinuity from a graph | | | | | | MSC: | Skill |
| 2. | ANS: | B | PTS: | 1 | DIF: | Med | REF: | Section 1.4 |
| OBJ: | Estimate a limit and points of discontinuity from a graph | | | | | | MSC: | Skill |
| 3. | ANS: | C | PTS: | 1 | DIF: | Med | REF: | Section 1.4 |
| OBJ: | Estimate a limit and points of discontinuity from a graph | | | | | | MSC: | Skill |
| 4. | ANS: | D | PTS: | 1 | DIF: | Easy | REF: | Section 1.4 |
| OBJ: | Evaluate one-sided limits | | | | | | MSC: | Skill |
| 5. | ANS: | D | PTS: | 1 | DIF: | Med | REF: | Section 1.4 |
| OBJ: | Evaluate one-sided limits | | | | | | MSC: | Skill |
| 6. | ANS: | D | PTS: | 1 | DIF: | Med | REF: | Section 1.4 |
| OBJ: | Evaluate one-sided limits | | | | | | MSC: | Skill |
| 7. | ANS: | A | PTS: | 1 | DIF: | Med | REF: | Section 1.4 |
| OBJ: | Evaluate one-sided limits | | | | | | MSC: | Skill |
| 8. | ANS: | C | PTS: | 1 | DIF: | Med | REF: | Section 1.4 |
| OBJ: | Evaluate one-sided limits | | | | | | MSC: | Skill |
| 9. | ANS: | C | PTS: | 1 | DIF: | Easy | REF: | Section 1.4 |
| OBJ: | Identify the discontinuities of a function if any exist | | | | | | MSC: | Skill |
| 10. | ANS: | D | PTS: | 1 | DIF: | Med | REF: | Section 1.4 |
| OBJ: | Identify the removable discontinuities of a function | | | | | | MSC: | Skill |
| 11. | ANS: | D | PTS: | 1 | DIF: | Easy | REF: | Section 1.4 |
| OBJ: | Identify the removable discontinuities of a function | | | | | | MSC: | Skill |
| 12. | ANS: | D | PTS: | 1 | DIF: | Med | REF: | Section 1.4 |
| OBJ: | Identify the removable discontinuities of a function | | | | | | MSC: | Skill |
| 13. | ANS: | C | PTS: | 1 | DIF: | Med | REF: | Section 1.4 |
| OBJ: | Identify the removable discontinuities of a function | | | | | | MSC: | Skill |
| 14. | ANS: | A | PTS: | 1 | DIF: | Med | REF: | Section 1.4 |
| OBJ: | Identify the removable discontinuities of a function | | | | | | MSC: | Skill |
| 15. | ANS: | E | PTS: | 1 | DIF: | Med | REF: | Section 1.4 |
| OBJ: | Identify the value of a parameter to ensure a function is continuous | | | | | | MSC: | Skill |
| 16. | ANS: | C | PTS: | 1 | DIF: | Med | REF: | Section 1.4 |
| OBJ: | Identify the value of a parameter to ensure a function is continuous | | | | | | MSC: | Skill |
| 17. | ANS: | B | PTS: | 1 | DIF: | Easy | REF: | Section 1.4 |
| OBJ: | Identify the value of c guaranteed by the Intermediate Value Theorem | | | | | | MSC: | Skill |
| 18. | ANS: | D | PTS: | 1 | DIF: | Med | REF: | Section 1.4 |
| OBJ: | Identify the value of c guaranteed by the Intermediate Value Theorem | | | | | | MSC: | Skill |
| 19. | ANS: | E | PTS: | 1 | DIF: | Med | REF: | Section 1.4 |
| OBJ: | Create functions in applications | | | | | | MSC: | Application |
| 20. | ANS: | E | PTS: | 1 | DIF: | Med | REF: | Section 1.4 |
| OBJ: | Identify the value of a parameter to ensure a function is continuous | | | | | | MSC: | Skill |

## 1.5 Infinite Limits

### Multiple Choice

*Identify the choice that best completes the statement or answers the question.*

____ 1. Determine whether $f(x) = \dfrac{x^{10}}{x^2 - 9}$ approaches $\infty$ or $-\infty$ as $x$ approaches $-3$ from the left and from the right by completing the tables below.

| $x$ | $-3.5$ | $-3.1$ | $-3.01$ | $-3.001$ |
|---|---|---|---|---|
| $f(x)$ | | | | |

| $x$ | $-2.999$ | $-2.99$ | $-2.9$ | $-2.5$ |
|---|---|---|---|---|
| $f(x)$ | | | | |

a. $\lim\limits_{x \to -3^-} f(x) = -\infty, \quad \lim\limits_{x \to -3^+} f(x) = \infty$

b. $\lim\limits_{x \to -3^-} f(x) = \infty, \quad \lim\limits_{x \to -3^+} f(x) = -\infty$

c. $\lim\limits_{x \to -3^-} f(x) = \infty, \quad \lim\limits_{x \to -3^+} f(x) = \infty$

d. $\lim\limits_{x \to -3^-} f(x) = -\infty, \quad \lim\limits_{x \to -3^+} f(x) = -\infty$

____ 2. Find all the vertical asymptotes (if any) of the graph of the function $f(x) = \dfrac{5}{(x-3)^2}$.

a. $x = -3$
b. $x = 5$
c. $x = 3, -3$
d. $x = 3$
e. no vertical asymptotes

____ 3. Find the vertical asymptotes (if any) of the function $f(x) = \dfrac{x^2 - 4}{x^2 + 3x + 2}$.

a. $x = 2$
b. $x = -1$
c. $x = 1$
d. $x = -2$
e. $x = -2$

____ 4. Find all the vertical asymptotes (if any) of the graph of the function $f(x) = \dfrac{1+x}{x^2(1-x)}$.

a. $x = -1$
b. $x = 1$
c. $x = 0$
d. $x = 1,\ x = 0$
e. no vertical asymptotes

____ 5. Find all the vertical asymptotes (if any) of the graph of the function $f(x) = \dfrac{x^3+8}{x+2}$.

a. $x = -2$
b. $x = 8$
c. $x = 2$
d. $x = 2, -2$
e. no vertical asymptotes

____ 6. Find all vertical asymptotes (if any) of the function $f(x) = \dfrac{x^2+4x+3}{x^3-4x^2-x+4}$.

a. $x = 4, 1$
b. $x = 4,\ 1,\ -1$
c. $x = -4, -1$
d. $x = 1$
e. $x = -1$

____ 7. Find the vertical asymptotes (if any) of the function $f(x) = \tan(15x)$.

a. $x = \dfrac{k}{15}\pi \quad \left(k = 0, \pm 1,\ \pm 2, \ldots\right)$
b. $x = \dfrac{2k+1}{30}\pi \quad \left(k = 0, \pm 1,\ \pm 2, \ldots\right)$
c. $x = \dfrac{2k}{15}\pi \quad \left(k = 0, \pm 1,\ \pm 2, \ldots\right)$
d. $x = \dfrac{2k+1}{15}\pi \quad \left(k = 0, \pm 1, \pm 2, \ldots\right)$
e. no vertical asymptotes

____ 8. Find the limit.

$$\lim_{x \to 14^+} \frac{x-3}{x-14}$$

a. 1
b. $-\infty$
c. 0
d. $\infty$
e. $-1$

____ 9. Find the limit.

$$\lim_{x \to -10} \frac{x^2 + 10x}{\left(x^2 + 100\right)(x + 10)}$$

a. $\frac{1}{20}$
b. $-\frac{1}{20}$
c. $20$
d. $-10$
e. $-20$

____ 10. Find the limit.

$$\lim_{x \to 0^-} \left(x^2 - \frac{1}{x}\right)$$

a. $1$
b. $0$
c. $-1$
d. $-\infty$
e. $\infty$

____ 11. Find the limit (if it exists).

$$\lim_{x \to \frac{1}{2}} x \tan \pi x$$

a. $\infty$
b. $-\infty$
c. $0$
d. $\frac{1}{2}$
e. Limit does not exist

____ 12. Use a graphing utility to graph the function $f(x) = \frac{x^2 - 2x + 4}{x^3 + 8}$ and determine the one-sided limit $\lim_{x \to -2^+} f(x)$.

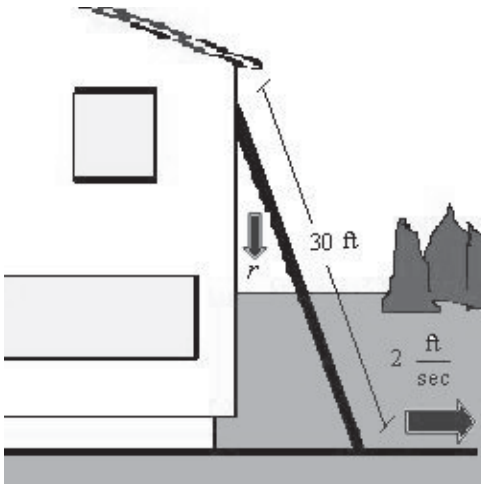
a. $-\infty$
b. $\infty$
c. $0$
d. $12$
e. $8$

____ 13. Use a graphing utility to graph the function $f(x) = \csc\frac{\pi x}{2}$ and determine the following one-sided limit.

$$\lim_{x \to 2^-} f(x)$$

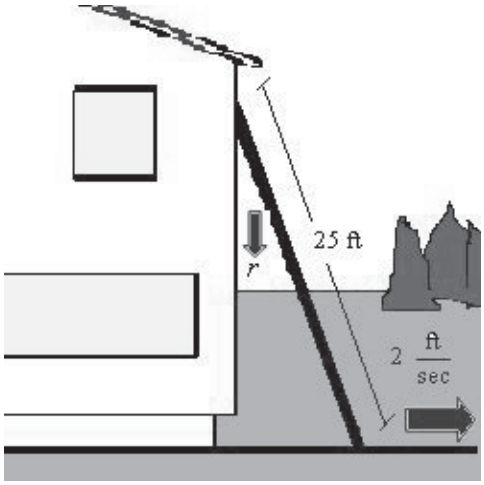
a. $-\infty$
b. $2$
c. $-2$
d. $\infty$
e. $0$

____ 14. A 30-foot ladder is leaning against a house (see figure). If the base of the ladder is pulled away from the house at a rate of 2 feet per second, the top will move down the wall at a rate of $r = \frac{2x}{\sqrt{900 - x^2}}$ ft / sec, where $x$ is the distance between the base of the ladder and the house. Find the rate $r$ when $x$ is 18 feet.




a. $r = \frac{3}{2}$ ft/sec
b. $r = \frac{4}{3}$ ft/sec
c. $r = \frac{48}{5}$ ft/sec
d. $r = \frac{2}{3}$ ft/sec
e. $r = \frac{3}{4}$ ft/sec

____ 15. A 25-foot ladder is leaning against a house (see figure). If the base of the ladder is pulled away from the house at a rate of 2 feet per second, the top will move down the wall at a rate of $r = \dfrac{2x}{\sqrt{625 - x^2}}$ ft / sec where $x$ is the distance between the base of the ladder and the house. Find the limit of $r$ as $x \to 25^-$.




a. $-\infty$
b. 50
c. 0
d. $\infty$
e. 25

## 1.5 Infinite Limits
## Answer Section

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. | ANS: | B | PTS: | 1 | DIF: | Med | REF: | Section 1.5 |
| OBJ: | Evaluate an infinite limit from a table of values | | | | | | MSC: | Skill |
| 2. | ANS: | D | PTS: | 1 | DIF: | Easy | REF: | Section 1.5 |
| OBJ: | Identify the vertical asymptotes (if any) of the graph of a function | | | | | | MSC: | Skill |
| 3. | ANS: | B | PTS: | 1 | DIF: | Med | REF: | Section 1.5 |
| OBJ: | Identify the vertical asymptotes (if any) of the graph of a function | | | | | | MSC: | Skill |
| 4. | ANS: | D | PTS: | 1 | DIF: | Med | REF: | Section 1.5 |
| OBJ: | Identify the vertical asymptotes (if any) of the graph of a function | | | | | | MSC: | Skill |
| 5. | ANS: | E | PTS: | 1 | DIF: | Med | REF: | Section 1.5 |
| OBJ: | Identify the vertical asymptotes (if any) of the graph of a function | | | | | | MSC: | Skill |
| 6. | ANS: | A | PTS: | 1 | DIF: | Med | REF: | Section 1.5 |
| OBJ: | Identify the vertical asymptotes (if any) of the graph of a function | | | | | | MSC: | Skill |
| 7. | ANS: | B | PTS: | 1 | DIF: | Med | REF: | Section 1.5 |
| OBJ: | Identify the vertical asymptotes (if any) of the graph of a function | | | | | | MSC: | Skill |
| 8. | ANS: | D | PTS: | 1 | DIF: | Med | REF: | Section 1.5 |
| OBJ: | Evaluate one-sided limits | | | | | | MSC: | Skill |
| 9. | ANS: | B | PTS: | 1 | DIF: | Med | REF: | Section 1.5 |
| OBJ: | Evaluate the limit of a function | | | | | | MSC: | Skill |
| 10. | ANS: | E | PTS: | 1 | DIF: | Med | REF: | Section 1.5 |
| OBJ: | Evaluate one-sided limits | | | | | | MSC: | Skill |
| 11. | ANS: | E | PTS: | 1 | DIF: | Med | REF: | Section 1.5 |
| OBJ: | Identify a limit that does not exist | | | | | | MSC: | Skill |
| 12. | ANS: | B | PTS: | 1 | DIF: | Med | REF: | Section 1.5 |
| OBJ: | Estimate one-sided limits from a graph | | | | | | MSC: | Skill |
| 13. | ANS: | D | PTS: | 1 | DIF: | Med | REF: | Section 1.5 |
| OBJ: | Estimate one-sided limits from a graph | | | | | | MSC: | Skill |
| 14. | ANS: | A | PTS: | 1 | DIF: | Easy | REF: | Section 1.5 |
| OBJ: | Evaluate functions in applications | | | | | | MSC: | Application |
| 15. | ANS: | D | PTS: | 1 | DIF: | Med | REF: | Section 1.5 |
| OBJ: | Evaluate limits in applications | | | | | | MSC: | Application |