1. **(1 pt) Problems/setM151_01_01_Real_Numbers_Functions_Equations_and_Graphs-/1.1.1.pg**
From Rogawski ET section 1.1, exercise 1.
Use a calculator to find a rational number r such that

$$|r-\pi^4| < 10^{-5}$$

$r =$ ________

2. **(1 pt) Problems/setM151_01_01_Real_Numbers_Functions_Equations_and_Graphs-/1.1.2.pg**
Let $a = -6$ and $b = 1$. Select every inequality which is true.
Which inequalities are true?

- A. $|a| < |b|$
- B. $\frac{a}{b} < 0$
- C. $ab > 0$
- D. $\frac{1}{b} < \frac{1}{a}$
- E. $a < b$

3. **(1 pt) Problems/setM151_01_01_Real_Numbers_Functions_Equations_and_Graphs-/1.1.3.pg**
From Rogawski ET section 1.1, exercise 3.
Express the interval in terms of an inequality involving absolute value:

$$[-4,4]$$

$|x| \le$ ________

4. **(1 pt) Problems/setM151_01_01_Real_Numbers_Functions_Equations_and_Graphs-/1.1.4.pg**
From Rogawski ET section 1.1, exercise 4.
Express the interval in terms of an inequality involving absolute value:

$$(-4,4)$$

$|x| <$ ________

5. **(1 pt) Problems/setM151_01_01_Real_Numbers_Functions_Equations_and_Graphs-/1.1.5.pg**
From Rogawski ET section 1.1, exercise 5.
Express the interval in terms of an inequality involving absolute value:

$$(0,4)$$

$|x+$ ________ $| <$ ________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: The correct solution is:

$$(-,)$$

;

6. **(1 pt) Problems/setM151_01_01_Real_Numbers_Functions_Equations_and_Graphs-/1.1.10.pg**
From Rogawski ET section 1.1, exercise 10.
Solve the inequality:

$$|x-2| < 7$$

Answer: ____________

Note: You may enter your answer in interval or inequality notation. If your solution includes a decimal value, please round to at least three decimal places. If the inequality has no solution, enter *No solution* .

7. **(1 pt) Problems/setM151_01_01_Real_Numbers_Functions_Equations_and_Graphs-/1.1.11.pg**
From Rogawski ET section 1.1, exercise 11.
Solve the following inequality. Enter the answer in interval notation.

$$|2x+1| \le 7$$

Answer: ____________

8. **(1 pt) Problems/setM151_01_01_Real_Numbers_Functions_Equations_and_Graphs-/1.1.13.pg**
From Rogawski ET section 1.1, exercise 13.
Express the set of numbers x satisfying the given condition as an interval:

$$|x| < 11$$

____

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: The correct solution is:

$$(-11,11)$$

;

9. **(1 pt) Problems/setM151_01_01_Real_Numbers_Functions_Equations_and_Graphs-/1.1.15.pg**
From Rogawski ET section 1.1, exercise 15.
Express the set of numbers x satisfying the given condition as an interval:

$$|x-9| < 10$$

____

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

The expression $|x-9| < 10$ is equivalent to $-10 < x-9 < 10$. Therefore $-1 < x < 19$, which represents the interval $(-1,19)$.

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10. **(1 pt) Problems/setM151_01_01_Real_Numbers_Functions_Equations_and_Graphs-/1.1.17.pg**

From Rogawski ET section 1.1, exercise 17.

Express the set of numbers x satisfying the given condition as an interval:

$$|7x-4| \le 5$$

_____

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

The expression $|7x-4| \le 5$ is equivalent to $-5 \le 7x-4 \le 5$.

Therefore $-1 \le 7x \le 9$and then $-\frac{1}{7} \le x \le \frac{9}{7}$, (or $-0.142857142857143 \le x \le 1.28571428571429$)

which represent the interval $[-\frac{1}{7}, \frac{9}{7}]$

---

11. **(1 pt) Problems/setM151_01_01_Real_Numbers_Functions_Equations_and_Graphs-/1.1.23.pg**

From Rogawski ET section 1.1, exercise 23.

Match the inequalities **1. - 6.** with the corresponding statements **A - F** :

___1. $|a-\frac{1}{10}| < 4$
___2. $|a-4| < \frac{1}{10}$
___3. $|a-3| < 10$
___4. $a > 10$
___5. $|a| > 4$
___6. $1 < a < 4$

A. a lies to the right of 10
B. The distance from a to 2.5 is at most 1.5
C. a lies either to the left of -4 or to the right of 4
D. a lies between -7 and 13
E. a is less than 4 units from 1/10
F. The distance from a to 4 is less than 1/10

Note that you only have four attempts on this question.

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

On the number line, numbers greater than 10 appear to the right:
hence $a > 10$ is equivalent to the numbers to the right of 10.

$|a-4|$ measures the distance from a to 4; hence $|a-4| < \frac{1}{10}$ is satisfied
by those numbers less than $\frac{1}{10}$ from 4

$|a-\frac{1}{10}|$ measures the distance from a to $\frac{1}{10}$; hence $|a-\frac{1}{10}| < 4$ is satisfied
by those numbers that are less than 4 units from $\frac{1}{10}$

The inequality $|a| > 4$ is equivalent to $a > 4$ or $a < -4$; that is, to the right of 4 or
to the left of -4.

The interval described by the inequality $|a-3| < 10$ has a center at 3 and a radius of 10; that is
the interval of those numbers between -7 and 13.

The interval described by the inequality $1 < x < 4$ has a center at 2.5 and a radius of 1.5

---

12. **(1 pt) Problems/setM151_01_01_Real_Numbers_Functions_Equations_and_Graph/1.1.31.pg**

From Rogawski ET section 1.1, exercise 31.

Express the repeating decimal $r1 = 0.\overline{27}$ as a fraction. **Hint:** $100r1 - r1$ is an integer.

_____

Then express the repeating decimal $r2 = 0.4\overline{6}$ as a fraction.

_____

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

Let $r1 = 0.\overline{27}$. We observe that $100r1 = 27.\overline{27}$. Therefore $100r1 - r1 = 27.\overline{27} - 0.\overline{27} = 99r1$.
Then $r1 = \frac{27}{99} = \frac{3}{11}$.

Now let $r2 = 0.4\overline{6}$. Then $100r2 = 46.\overline{6}$. Therefore $100r2 - 10r2 = 90r2 = 42$
and $r2 = \frac{42}{90} = \frac{7}{15}$

---

13. **(1 pt) Problems/setM151_01_01_Real_Numbers_Functions_Equations_and_Graph/1.1.40.pg**

Find domain and range of the function:

$$f(x) = -13x$$

Domain: ____________________
Range: ____________________

Note: Write the answer in interval notation. If the answer includes more than one interval write the intervals separated by the "union" symbol, U. If needed enter $-\infty$ as - *infinity* and ∞ as *infinity* .

---

14. **(1 pt) Problems/setM151_01_01_Real_Numbers_Functions_Equations_and_Graph/1.1.41.pg**

Find domain and range of the function

$$g(t) = t^4$$

Domain: ____________________
Range: ____________________

Note: Write the answer in interval notation. If the answer includes more than one interval write the intervals separated by the "union" symbol, U. If needed enter $-\infty$ as - *infinity* and ∞ as *infinity* .

15. **(1 pt) Problems/setM151_01_01_Real_Numbers_Functions_Equations_and_Graphs-/1.1.43.pg**

Find domain and range of the function

$$f(x) = \sqrt{100 - 5x}$$

Domain: ____________________

Range: ____________________

Note: Write the answer in interval notation. If the answer includes more than one interval write the intervals separated by the "union" symbol, U. If needed enter $-\infty$ as - *infinity* and ∞ as *infinity* .

16. **(1 pt) Problems/setM151_01_01_Real_Numbers_Functions_Equations_and_G /1.1.49.pg**

From Rogawski ET section 1.1, exercise 49.

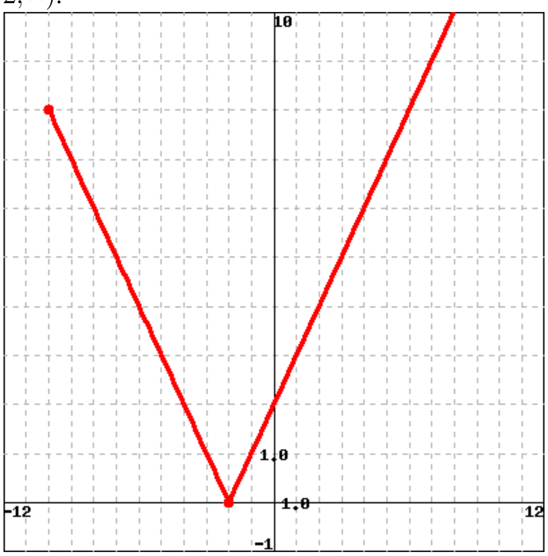
Find the interval on which the function $f(x) = |x+2|$ is increasing:

_____

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

A graph of the function $y = |x+2|$ is shown below. From the graph we see that the function is increasing on the interval $(-2, \infty)$.



17. **(1 pt) Problems/setM151_01_01_Real_Numbers_Functions_Equations_and_Graphs-/1.1.51.pg**

From Rogawski ET section 1.1, exercise 51.

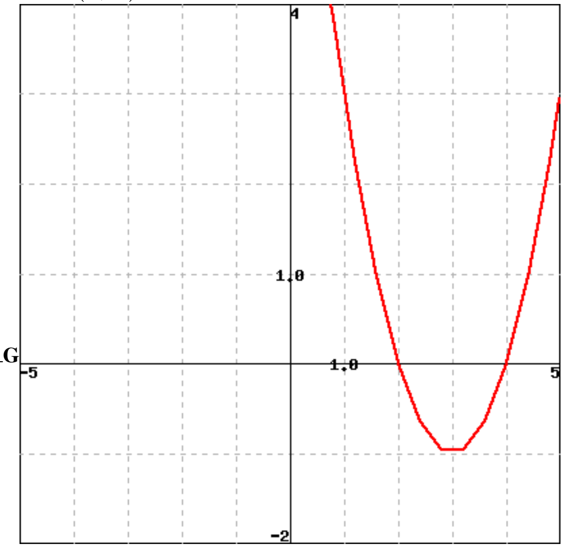
Find the interval on which the function $f(x) = (x-3)^2 - 1$ is increasing:

_____

SOLUTION: (Instructor solution preview: show the student solution after due date.)

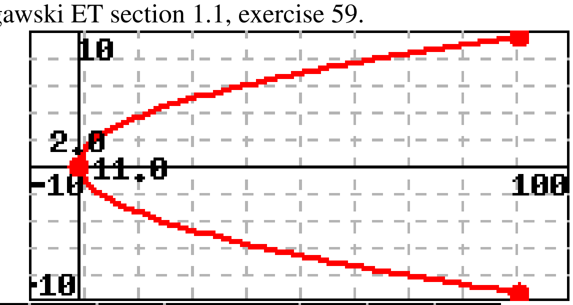
Solution:

A graph of the function $y = (x-3)^2 - 1$ is shown below. From the graph we see that the function is increasing on the interval $(3, \infty)$

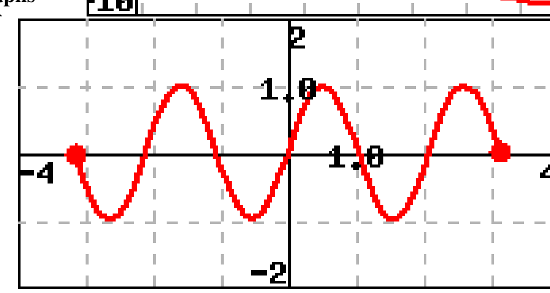


18. **(1 pt) Problems/setM151_01_01_Real_Numbers_Functions_Equations_and_Graph /1.1.59.pg**

From Rogawski ET section 1.1, exercise 59.

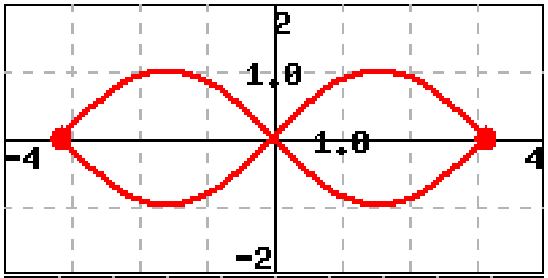


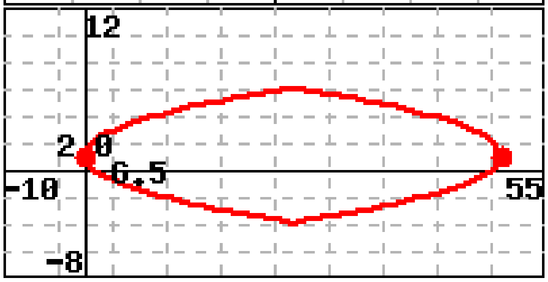
A



B

C





D

Which one of the graphs is a function? ____

A.
B.
C.
D.

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:
(B) is the graph of a function. **(C)** , **(A)** , and **(D)** all fail the vertical line test.

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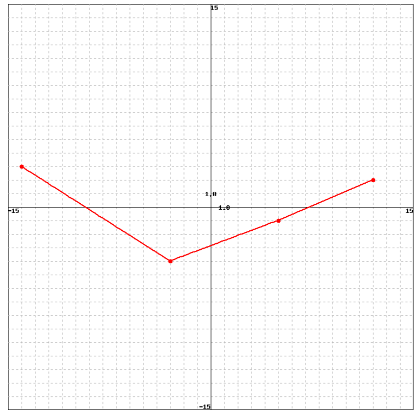
19. **(1 pt) Problems/setM151_01_01_Real_Numbers_Functions_Equations_and_Graphs/1.1.61.pg**
From Rogawski ET section 1.1, exercise 61.



What are the domain and range of $f(x)$ shown in the graph above?
Domain: ________
Range: ________
Evaluate: $f(-3) =$ ____

---

20. **(1 pt) Problems/setM151_01_01_Real_Numbers_Functions_Equations_and_Graphs/1.1.67.pg**
From Rogawski ET section 1.1, exercise 67.

Suppose that $f(x)$ has a domain of $[6,17]$ and a range of $[8,15]$. What are the domain and range of:
(a) $f(x)+4$ **Domain** ____ **Range** ____
(b) $f(x+4)$ **Domain** ____ **Range** ____
(c) $f(4x)$ **Domain** ____ **Range** ____
(d) $4f(x)$ **Domain** ____ **Range** ____

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:
(a) $f(x)+4$ is obtained by shifting $f(x)$ upwards by 4 units. Therefore the domain remains $[6,17]$ while the range becomes $[12,19]$.
(b) $f(x+4)$ is obtained by shifting $f(x)$ by 4 units left along the x axis. Therefore the domain becomes $[2,13]$ while the range remains $[8,15]$
(c) $f(4x)$ is obtained by compressing $f(x)$ by a factor of 4. Therefore the domain becomes $[\frac{6}{4},\frac{17}{4}]$ while the range remains $[8,15]$.
(d) $4f(x)$ is obtained by stretching $f(x)$ vertically by a factor of 4. Therefore the domain remains $[6,17]$ while the range becomes $[32,60]$.

1. **(1 pt) Problems/setM151_01_02_Linear_and_Quadratic_Functions-/1.2.1.pg**
From Rogawski ET section 1.2, exercise 1.

Find the slope, the y-intercept, and the x-intercept of the line $y = 35 - 7x$.

slope: ______
y-intercept: ______
x-intercept: ______

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Because the equation of the line is given in slope-intercept form, the slope is the coefficient of x and the y-intercept is the constant term: that is, $m = -7$ and the y-intercept is 35. To determine the x-intercept, substitute $y = 0$ and then solve for x: $0 = 35 - 7x$ or $x = 5$.

2. **(1 pt) Problems/setM151_01_02_Linear_and_Quadratic_Functions-/1.2.3.pg**
From Rogawski ET section 1.2, exercise 3.

Find the slope, the y-intercept, and the x-intercept of the line $7x + 3y = -2$.

slope: ______
y-intercept: ______
x-intercept: ______

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: To determine the slope and y-intercept, we first solve the equation for y to obtain the slope-intercept form. This yields $y = -\frac{7}{3}x - \frac{2}{3}$. From here, we see that the slope is $m = -\frac{7}{3}$ and the y-intercept is $-\frac{2}{3}$. To determine the x-intercept, substitute $y = 0$ and solve for x: $7x = -2$ or $x = -\frac{2}{7}$.

3. **(1 pt) Problems/setM151_01_02_Linear_and_Quadratic_Functions-/1.2.5.pg**
From Rogawski ET section 1.2, exercise 5.

Find the slope of the line $y = 6x - 3$.

______

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: $m = 6$

4. **(1 pt) Problems/setM151_01_02_Linear_and_Quadratic_Functions-/1.2.7.pg**
From Rogawski ET section 1.2, exercise 7.

Find the slope of the line $10y - 6x = -10$.

______

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: First solve the equation for y to obtain the slope-intercept form. This yields $y = \frac{3}{5}x - 1$. The slope of the line is therefore $m = \frac{3}{5}$.

5. **(1 pt) Problems/setM151_01_02_Linear_and_Quadratic_Functions-/1.2.9.pg**
From Rogawski ET section 1.2, exercise 9.

The equation of the line that has slope 2 and y-intercept -8 can be written in the form $y = mx + b$ where
$m =$ ______
$b =$ ______

6. **(1 pt) Problems/setM151_01_02_Linear_and_Quadratic_Functions-/1.2.11.pg**
From Rogawski ET section 1.2, exercise 11.

The equation of the line that has slope 3 and passes through the point $(3, -4)$ can be written in the form $y = mx + b$ where
$m =$ ______
$b =$ ______

7. **(1 pt) Problems/setM151_01_02_Linear_and_Quadratic_Functions-/1.2.13.pg**
From Rogawski ET section 1.2, exercise 13.

The equation of the line that is horizontal and passes through the point $(4, -9)$ can be written in the form $y = mx + b$ where
$m =$ ______
$b =$ ______

8. **(1 pt) Problems/setM151_01_02_Linear_and_Quadratic_Functions-/1.2.15.pg**
From Rogawski ET section 1.2, exercise 15.

The equation of the line that passes through the point $(9, 9)$ and is parallel to the line $2x + 3y = 2$ can be written in the form $y = mx + b$ where
$m =$ ______
$b =$ ______

9. **(1 pt) Problems/setM151_01_02_Linear_and_Quadratic_Functions-/1.2.17.pg**
From Rogawski ET section 1.2, exercise 17.

The equation of the line that passes through the point $(6, 9)$ and is perpendicular to the line $4x + 2y = 2$ can be written in the form $y = mx + b$ where
$m =$ ______
$b =$ ______

10. **(1 pt) Problems/setM151_01_02_Linear_and_Quadratic_Functions-/1.2.23.pg**
From Rogawski ET section 1.2, exercise 23.

The equation of the line that has x-intercept 1 and y-intercept 2 can be written in the form $y = mx + b$ where
$m =$ ______
$b =$ ______

11. **(1 pt) Problems/setM151_01_02_Linear_and_Quadratic_Functions-/1.2.24.pg**
From Rogawski ET section 1.2, exercise 24.

A line of slope $m = 5$ passes through the point $(1,8)$. Find y such that $(7,y)$ lies on the line.

$y =$ _______

12. **(1 pt) Problems/setM151_01_02_Linear_and_Quadratic_Functions-/1.2.25.pg**
From Rogawski ET section 1.2, exercise 25.

Determine whether there exists a constant c such that the line $x + cy = -8$

Has slope -8 _________

Passes through $(-9,-7)$ _________

Is horizontal _________

Is vertical _________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Rewriting the equation of the line in slope-intercept form gives $y = -\frac{x}{c} + \frac{1}{c}$. To have slope -8 requires $-\frac{1}{c} = -8$ or $c = \frac{1}{8}$.

Substituting $x = -9$ and $y = -7$ into the equation of the line gives $-9 - 7c = -8$ or $c = -\frac{1}{7}$.

From (a), we know the slope of the line is $-\frac{1}{c}$. There is no value for c that will make this slope equal to 0.

With $c = 0$, the equation becomes $x = -8$. This is the equation of a vertical line.

13. **(1 pt) Problems/setM151_01_02_Linear_and_Quadratic_Functions-/1.2.27.pg**
From Rogawski ET section 1.2, exercise 27.

Materials expand when heated. Consider a metal rod of length L_0 at temperature T_0. If the temperature is changed by an amount ΔT, then the rod's length changes by $\Delta L = \alpha L_0 \Delta T$, where α is the thermal expansion coefficient. For steel, $\alpha = 1.24 \times 10^{-5}$ °C^{-1}.

(a) A steel rod has length $L_0 = 60$ cm at $T_0 = 20$°C. What is the length at $T = 80$°C?

_______ cm

(b) Find its length at $T = 70$°C if its length at $T_0 = 40$°C is $L_0 = 55$ in.

_______ in

(c) Express L as a function of T if $L_0 = 55$ in. at $T_0 = 40$°C.

_________ Note: Type 'a' for 'α' and note that WeBWorK is case-sensitive.

14. **(1 pt) Problems/setM151_01_02_Linear_and_Quadratic_Functions-/1.2.29.pg**
From Rogawski ET section 1.2, exercise 29.

Find x such that $(-10,-3)$, $(0,-10)$, and $(x,-8)$ lie on a line.

$x =$ _________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: The slope of the line determined by the points $(-10,-3)$ and $(0,-10)$ is

$$\frac{-10-(-3)}{0-(-10)} = -\frac{7}{10}.$$

To lie on the same line, the slope between $(0,-10)$ and $(b,-8)$ must also be $-\frac{7}{10}$. Thus, we require

$$\frac{-8-(-10)}{b-0} = \frac{2}{b} = -\frac{7}{10},$$

or $b = -\frac{20}{7}$.

15. **(1 pt) Problems/setM151_01_02_Linear_and_Quadratic_Functions-/1.2.31.pg**
From Rogawski ET section 1.2, exercise 31.

The electrical current I flowing through a wire is measured when different voltages V are applied. Based on the following data, does I appear to be a linear function of V?

V (V)	0.5	2	3.5	5
I (A)	0.088	0.353	0.618	0.883

- A. Yes
- B. No

Note that you only have one attempt on this question.

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Examine the slope between consecutive data points. The first pair of data points yields a slope of

$$\frac{0.353-0.088}{2-0.5} \approx 0.1767,$$

while the second pair of data points yields a slope of

$$\frac{0.618-0.353}{3.5-2} \approx 0.1767,$$

and the last pair of data points yields a slope of

$$\frac{0.883-0.618}{5-3.5} \approx 0.1767.$$

Because the three slopes are equal, I appears to be a linear function of V.

16. **(1 pt) Problems/setM151_01_02_Linear_and_Quadratic_Functions-/1.2.33.pg**
From Rogawski ET section 1.2, exercise 33.

Find the roots of the quadratic polynomials. If the polynomial has more than one root, enter your answers separated by a comma.

a) $6 - \left(6x^2 + 9x\right)$

Answer: _________

b) $5x^2 + x - 9$

Answer: _________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:
$x = \frac{9\pm\sqrt{81-4(-6)(6)}}{2(-6)} = \frac{9\pm\sqrt{225}}{-12} = -2$ or $\frac{1}{2}$
$x = \frac{-1\pm\sqrt{1-4(5)(-9)}}{2(5)} = \frac{-1\pm\sqrt{181}}{10} = 1.24536$ or -1.44536

---

17. **(1 pt) Problems/setM151_01_02_Linear_and_Quadratic_Functions-/1.2.35.pg**
From Rogawski ET section 1.2, exercise 35. Complete the square and find the minimum or maximum value of the quadratic function $y = x^2 - 14x + 49$.

$\boxed{?}$1. value is ______

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: $y = (x-7)^2$; therefore, the minimum value of the quadratic polynomial is 0, and this occurs at $x = 7$.

---

18. **(1 pt) Problems/setM151_01_02_Linear_and_Quadratic_Functions-/1.2.37.pg**
From Rogawski ET section 1.2, exercise 37. Complete the square and find the minimum or maximum value of the quadratic function $y = x^2 - 18x + 84$.

$\boxed{?}$1. value is ______

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: $y = x^2 - 18x + 81 - 81 + 84 = (x-9)^2 + 3$; therefore, the minimum value of the quadratic polynomial is 3, and this occurs at $x = 9$.

---

19. **(1 pt) Problems/setM151_01_02_Linear_and_Quadratic_Functions-/1.2.39.pg**
From Rogawski ET section 1.2, exercise 39. Complete the square and find the minimum or maximum value of the quadratic function $y = 1 - \left(9x^2 + 5x\right)$.

$\boxed{?}$1. value is ______

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: $y = 1 - \left(9x^2 + 5x\right) = -9\left(x^2 + \frac{5}{9}x + \frac{25}{324}\right) + 1 + \frac{25}{36} = -9\left(x + \frac{5}{18}\right)^2 + \frac{61}{36}$; therefore, the maximum value of the quadratic polynomial is $\frac{61}{36}$, and this occurs at $x = -\frac{5}{18}$.

---

20. **(1 pt) Problems/setM151_01_02_Linear_and_Quadratic_Functions-/1.2.41.pg**
From Rogawski ET section 1.2, exercise 41. Complete the square and find the minimum or maximum value of the quadratic function $y = 5x^2 - 7x$.

$\boxed{?}$1. value is ______

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: $y = 5x^2 - 7x = 5\left(x^2 - \frac{7}{5}x + \frac{49}{100}\right) - \frac{49}{20} = 5\left(x - \frac{7}{10}\right)^2 - \frac{49}{20}$; therefore, the minimum value of the quadratic polynomial is $-\frac{49}{20}$, and this occurs at $x = \frac{7}{10}$.

---

1. **(1 pt) Problems/setM151_01_03_Function_Classes/1.3.1.pg**
From Rogawski ET section 1.3, exercise 1.

Determine the domain of the function.
$f(x) = x^{0.75}$

- A. $x \geq 0$
- B. $x \neq 0$
- C. all Real numbers
- D. $x \leq 0$

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Since we're working on the real-number plane, x must be positive (negatives lead to imaginary numbers).

---

2. **(1 pt) Problems/setM151_01_03_Function_Classes/1.3.5.pg**
From Rogawski ET section 1.3, exercise 5.

Determine the domain of the function.
$f(x) = \frac{1}{x+1}$

- A. $x \neq -1$
- B. $x \leq -1$
- C. $x \geq -1$
- D. all Real numbers

Note that you only have two attempts on this question.

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: The domain of a rational function $\frac{P(x)}{Q(x)}$ is the set of numbers x such that $Q(x) \neq 0$.

---

3. **(1 pt) Problems/setM151_01_03_Function_Classes/1.3.13.pg**
From Rogawski ET section 1.3, exercise 13.

Identify the following function as polynomial, rational, algebraic, or transcendental.
$f(x) = 9x^3 + 8x^2 - 9x - 3$

- A. algebraic
- B. polynomial
- C. transcendental
- D. rational

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: A polynomial is a sum of multiples of power functions ($g(x) = x^m$) with whole number exponents.

This is a polynomial, since x^3, x^2, x^1, and x^0 are all power functions with whole number exponents, and the given expression is a sum of multiples of those power functions.

---

4. **(1 pt) Problems/setM151_01_03_Function_Classes/1.3.15.pg**
From Rogawski ET section 1.3, exercise 15.

Identify the following function as polynomial, rational, algebraic, or transcendental.
$f(x) = \sqrt{10x^3 + 9x^2 - 6x - 2}$

- A. algebraic
- B. transcendental
- C. polynomial
- D. rational

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: An algebraic function is produced by taking sums, products, and quotients of roots of polynomials and rational functions.

This is an algebraic function, since $10x^3 + 9x^2 - 6x - 2$ is a polynomial and the given function is the root of $10x^3 + 9x^2 - 6x - 2$.

---

5. **(1 pt) Problems/setM151_01_03_Function_Classes/1.3.19.pg**
From Rogawski ET section 1.3, exercise 19.

Identify the following function as polynomial, rational, algebraic, or transcendental.
$f(x) = \frac{2x^3}{9-10x^2}$

- A. rational
- B. algebraic
- C. polynomial
- D. transcendental

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Rational.

---

6. **(1 pt) Problems/setM151_01_03_Function_Classes/1.3.21.pg**
From Rogawski ET section 1.3, exercise 21.

Identify the following function as polynomial, rational, algebraic, or transcendental.
$f(x) = \sin(3x^2 + 1)$

- A. rational
- B. transcendental
- C. polynomial
- D. algebraic

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Transcendental.

---

7. **(1 pt) Problems/setM151_01_03_Function_Classes/1.3.23.pg**
From Rogawski ET section 1.3, exercise 23.

Identify the following function as polynomial, rational, algebraic, or transcendental.

$f(x) = 1x^2 - 6x + 6x^{-1}$

- A. algebraic
- B. rational
- C. transcendental
- D. polynomial

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Rational.

---

8. **(1 pt) Problems/setM151_01_03_Function_Classes/1.3.25.pg**
From Rogawski ET section 1.3, exercise 25.

Is $f(x) = 3^{x^2}$ a transcendental function?

- A. yes
- B. no

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Yes.

---

9. **(1 pt) Problems/setM151_01_03_Function_Classes/1.3.27.pg**
From Rogawski ET section 1.3, exercise 27.

Calculate the composite functions $f \circ g$ and $g \circ f$, and determine their domains.

$f(x) = \sqrt{2x},\ g(x) = x + 3$

$f(g(x)) =$ ________ Domain: ________

$g(f(x)) =$ ________ Domain: ________

Note: Write the domain in interval notation. If the domain includes more than one interval write the intervals separated by the "union" symbol, U. If needed enter $-\infty$ as - *infinity* and ∞ as *infinity* .

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

$$f(g(x)) = 2^{x^3}; D : \Re$$

$$g(f(x)) = 2^{3x}; D : \Re$$

---

10. **(1 pt) Problems/setM151_01_03_Function_Classes/1.3.29.pg**
From Rogawski ET section 1.3, exercise 29.

Calculate the composite functions $f \circ g$ and $g \circ f$, and determine their domains.

$$f(x) = 5^x, g(x) = x^2$$

$f(g(x)) =$ ________ Domain: ________

$g(f(x)) =$ ________ Domain: ________

Note: Write the domain in interval notation. If the domain includes more than one interval write the intervals separated by the "union" symbol, U. If needed enter $-\infty$ as - *infinity* and ∞ as *infinity* .

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

$$f(g(x)) = 5^{x^2}; D : \Re$$
$$g(f(x)) = 5^{2x}; D : \Re$$

---

11. **(1 pt) Problems/setM151_01_03_Function_Classes/1.3.31.pg**
From Rogawski ET section 1.3, exercise 31.

Calculate the composite functions $f \circ g$ and $g \circ f$, and determine their domains.

$$f(x) = \cos(x), g(x) = 2x^3 + 8x^2 - 6$$

$f(g(x)) =$ ________ Domain: ________

$g(f(x)) =$ ________ Domain: ________

Note: Write the domain in interval notation. If the domain includes more than one interval write the intervals separated by the "union" symbol, U. If needed enter $-\infty$ as - *infinity* and ∞ as *infinity* .

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

$$f(g(x)) = (cos(2 * x^3 + 8 * x^2 - 6)); D : \Re$$
$$g(f(x)) = (2 * [cos(x)]^3 + 8 * [cos(x)]^2 - 6); D : \Re$$

1. **(1 pt) Problems/setM151_02_02_Numerical_Graphical_Limits-/2.2.1.pg**

From Rogawski ET section 2.2, exercise 1.

Fill in the table and guess the value of the limit:

$\lim_{x\to 2} f(x)$, where $f(x) = \frac{x^3-8}{x^2-4}$

x	$f(x)$
2.002	___
2.001	___
2.0005	___
2.0001	___
1.9999	___
1.9995	___
1.999	___
1.998	___

$\lim_{x\to 2} \frac{x^3-8}{x^2-4} =$ ___

2. **(1 pt) Problems/setM151_02_02_Numerical_Graphical_Limits-/2.2.2.pg**

From Rogawski ET section 2.2, exercise 2.

Fill in the table and guess the value of the limit:

$\lim_{x\to 0} f(x)$, where $f(x) = \frac{\cos(x)-1}{4x}$

x	$f(x)$
0.002	___
0.001	___
0.0005	___
0.0001	___
-0.0001	___
-0.0005	___
-0.001	___
-0.002	___

$\lim_{x\to 0} \frac{\cos(x)-1}{4x} =$ ___

3. **(1 pt) Problems/setM151_02_02_Numerical_Graphical_Limits-/2.2.3.pg**

From Rogawski ET section 2.2, exercise 3.

Fill in the table and guess the value of the limit:

$\lim_{x\to 8} f(x)$, where $f(x) = \frac{x^2-12x+32}{x^2-17x+72}$

x	$f(x)$
8.002	___
8.001	___
8.0001	___
7.9999	___
7.999	___
7.998	___

$\lim_{x\to 8} \frac{x^2-12x+32}{x^2-17x+72} =$ ___

4. **(1 pt) Problems/setM151_02_02_Numerical_Graphical_Limits-/2.2.5.pg**

From Rogawski ET section 2.2, exercise 5.

Fill in the table and guess the value of the limit:

$\lim_{x\to 0} f(x)$, where $f(x) = \frac{e^x-x-1}{3x^2}$

x	0.5	0.1	0.05	0.01	0.001
$f(x)$	___	___	___	___	___

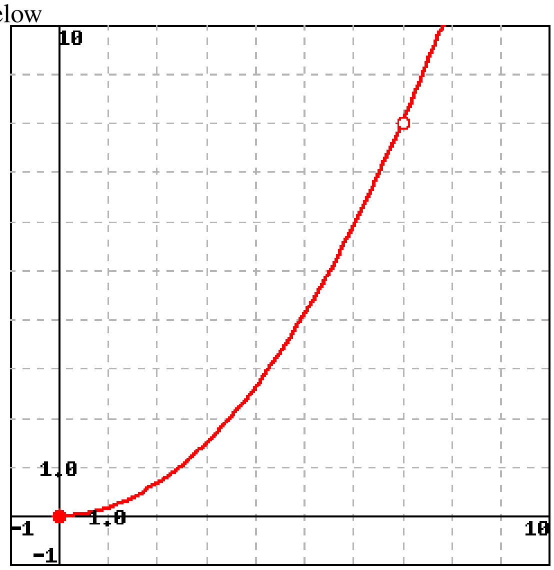
x	-0.001	-0.01	-0.05	-0.1	-0.5
$f(x)$	___	___	___	___	___

$\lim_{x\to 0} \frac{e^x-x-1}{3x^2} =$ ___

5. **(1 pt) Problems/setM151_02_02_Numerical_Graphical_Limits-/2.2.7.pg**

From Rogawski ET section 2.2, exercise 7.

Determine $\lim_{x\to 7} f(x)$ for the function $f(x)$ shown in the figure below



The limit as $x \to 7$ is ___

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

The graph suggests that $f(x) \to 8$ as $x \to 7$

6. **(1 pt) Problems/setM151_02_02_Numerical_Graphical_Limits-/2.2.9.pg**
From Rogawski ET section 2.2, exercise 9,10.

(a) Evaluate the limit:

$\lim_{x\to 13} x =$ ___

(b) Evaluate the limit:

$\lim_{x\to 4.1} \sqrt{5} =$ ___

---

7. **(1 pt) Problems/setM151_02_02_Numerical_Graphical_Limits-/2.2.13.pg**
From Rogawski ET section 2.2, exercise 13.

Verify that $\lim_{x\to 5} 3x+2 = 17$ using the limit definition. *See Example 1.*

Solution: Let $f(x) = 3x+2$. To show that $\lim_{x\to 5} 3x+2 = 17$, we must show that _____ becomes $\boxed{?}$ when x is sufficiently close (but not equal to) ___.

We have
$|f(x)-17| = |$ _____ $-17| = |$ _____ $| =$ ___ $|$ _____ $|$.

Since $|f(x)-17| =$ is a multiple of ___,
we can make _____ $\boxed{?}$ by taking x sufficiently close to ___.
QED

---

8. **(1 pt) Problems/setM151_02_02_Numerical_Graphical_Limits-/2.2.21.pg**
From Rogawski ET section 2.2, exercise 21.

Estimate the limit numerically or state that the limit doesn't exist.

$\lim_{x\to 5} \frac{\sqrt{x}-5}{x-25} =$ __________

Enter **inf** for ∞, **-inf** for $-\infty$, and **DNE** if the limit does not exist.

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

x	$f(x)$	x	$f(x)$
5.002	0.138188061487005	4.998	0.138205143526948
5.001	0.138192330960632	4.999	0.138200871980372
5.0005	0.138194465956463	4.9995	0.138198736466304
5.0001	0.138196174077482	4.9999	0.138197028179449

The limit as $x \to 1$ is 0.13820.

---

9. **(1 pt) Problems/setM151_02_02_Numerical_Graphical_Limits-/2.2.23.pg**
From Rogawski ET section 2.2, exercise 23.

Estimate the limit numerically or state that the limit doesn't exist.

$\lim_{x\to 5} \frac{x^2-3x-10}{x^2-4x-5} =$ ___

Enter **inf** for ∞, **-inf** for $-\infty$, and **DNE** if the limit does not exist.

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

x	$f(x)$	x	$f(x)$
5.002	1.16661112962346	4.998	1.16672224074692
5.001	1.16663889351775	4.999	1.16669444907485
5.0005	1.16665277893509	4.9995	1.16668055671306
5.0001	1.16666388893518	4.9999	1.16666944449074

The limit as $x \to 5$ is $\frac{7}{6}$

---

10. **(1 pt) Problems/setM151_02_02_Numerical_Graphical_Limits-/2.2.25.pg**
From Rogawski ET section 2.2, exercise 25.

Estimate the limit numerically or state that the limit doesn't exist.

$\lim_{x\to 0} \frac{\sin(5x)}{x} =$ ___

Enter **inf** for ∞, **-inf** for $-\infty$, and **DNE** if the limit does not exist.

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

x	-0.01	-0.005	0.005	
$f(x)$	4.99791692706783	4.99947918294247	4.99947918294247	4

The limit as $x \to 0$ is 5

---

11. **(1 pt) Problems/setM151_02_02_Numerical_Graphical_Limits-/2.2.27.pg**
From Rogawski ET section 2.2, exercise 27.

Estimate the limit numerically or state that the limit doesn't exist.

$\lim_{x\to 0} \frac{\sin 8x}{x^2} =$ ___

Enter **inf** for ∞, **-inf** for $-\infty$, and **DNE** if the limit does not exist.

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

x	-0.001	-0.0001	0.0001	
$f(x)$	-7999.91466693973	-79999.991466667	79999.991466667	79

The limit doesn't exist. As $x \to 0-, f(x) \to -\infty$; similarly, as $x \to 0+, f(x) \to \infty$.

12. **(1 pt) Problems/setM151_02_02_Numerical_Graphical_Limits-/2.2.29.pg**

From Rogawski ET section 2.2, exercise 29.

Estimate the limit numerically or state that the limit doesn't exist.

$\lim_{h\to 0} \cos\left(\frac{9}{h}\right) =$ ___

Enter **inf** for ∞, **-inf** for $-\infty$, and **DNE** if the limit does not exist.

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

x	plusmn;0.001	plusmn;0.1	plusmn;0.0001	plusmn;0.01
$f(x)$	-0.448074	0.0662467	-0.788179	0.940621

The limit doesn't exist since $\cos\left(\frac{9}{h}\right)$ oscillates infinitely often as $h \to 0$.

13. **(1 pt) Problems/setM151_02_02_Numerical_Graphical_Limits-/2.2.31.pg**

From Rogawski ET section 2.2, exercise 31.

Estimate the limit numerically or state that the limit doesn't exist.

$\lim_{h\to 0} \frac{4^h-1}{h} =$ ___

Enter **inf** for ∞, **-inf** for $-\infty$, and **DNE** if the limit does not exist.

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

h	-0.05	-0.001	0.001
$f(h)$	1.33934016926385	1.38533389897111	1.38725571133458

The limit as $x \to 0$ is approximately 1.38629436111989. (The exact answer is $\ln 4$).

14. **(1 pt) Problems/setM151_02_02_Numerical_Graphical_Limits-/2.2.33.pg**

From Rogawski ET section 2.2, exercise 33.

Estimate the limit numerically or state that the limit doesn't exist.

$\lim_{x\to 1+} \frac{\sec^{-1}(x)}{\sqrt{x^2-1}} =$ ________

Enter **inf** for ∞, **-inf** for $-\infty$, and **DNE** if the limit does not exist.

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

x	1.01	1.001	1.0005	1.0001
$f(x)$	0.99338	0.999334	0.999667	0.999933

The limit as $x \to 1+$ is $\frac{\sqrt{2}\sqrt{2}}{2} \approx 1$.

15. **(1 pt) Problems/setM151_02_02_Numerical_Graphical_Limits-/2.2.35.pg**

From Rogawski ET section 2.2, exercise 35.

Estimate the limit numerically or state that the limit doesn't exist.

$\lim_{x\to 0} \frac{\tan^{-1}(9x)}{\sin^{-1}(x)-x} =$ ________

Enter **inf** for ∞, **-inf** for $-\infty$, and **DNE** if the limit does not exist.

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

x	-0.001	-0.0001	0.0001	
$f(x)$	53998517.7912643	5399998270.84354	5399998270.84354	5

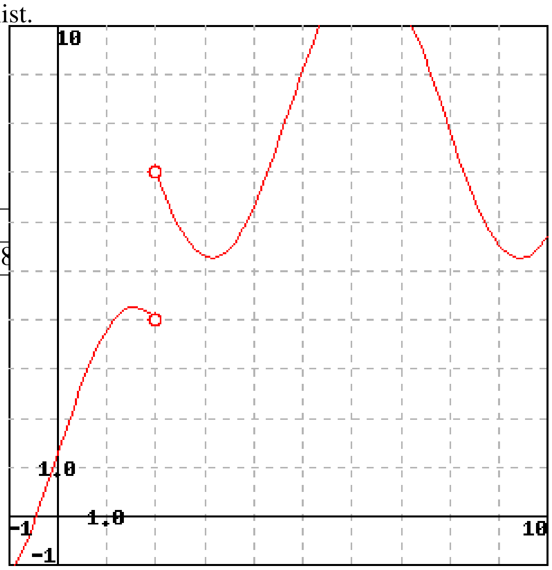
As $x \to 0, f(x) \to \infty$, so the limit doesn't exist.

16. **(1 pt) Problems/setM151_02_02_Numerical_Graphical_Limits-/2.2.37.pg**

From Rogawski ET section 2.2, exercise 37.

Determine $\lim_{x\to 2+} f(x)$, $\lim_{x\to 2-} f(x)$, and $\lim_{x\to 2} f(x)$ for the function shown in figure.

Enter **inf** for ∞, **-inf** for $-\infty$, and **DNE** if the limit does not exist.



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

$\lim_{x\to 2+} f(x) =$ ___

$\lim_{x\to 2} f(x) =$ ___

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

The left hand limit is $\lim_{x\to 2-} f(x) = 4$, whereas the right-hand limit is $\lim_{x\to 2+} f(x) = 7$. Accordingly the two-sided limit doesn't exist.

17. (1 pt) **Problems/setM151_02_02_Numerical_Graphical_Limits-/2.2.38.pg**

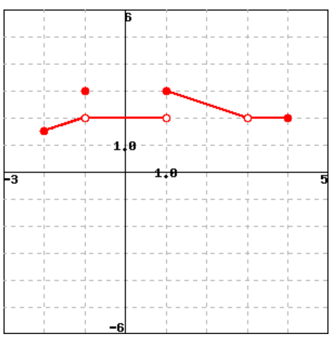
From Rogawski ET section 2.2, exercise 38.

Let F be the function whose graph is shown below.

Evaluate each of the following expressions.

Enter **inf** for ∞, **-inf** for $-\infty$, and **DNE** if the limit does not exist.

1. $\lim_{x\to -1^-} F(x) =$ ___
2. $\lim_{x\to -1^+} F(x) =$ ___
3. $\lim_{x\to -1} F(x) =$ ___
4. $F(-1) =$ ___
5. $\lim_{x\to 1^-} F(x) =$ ___
6. $\lim_{x\to 1^+} F(x) =$ ___
7. $\lim_{x\to 1} F(x) =$ ___
8. $\lim_{x\to 3} F(x) =$ ___
9. $F(3) =$ ___



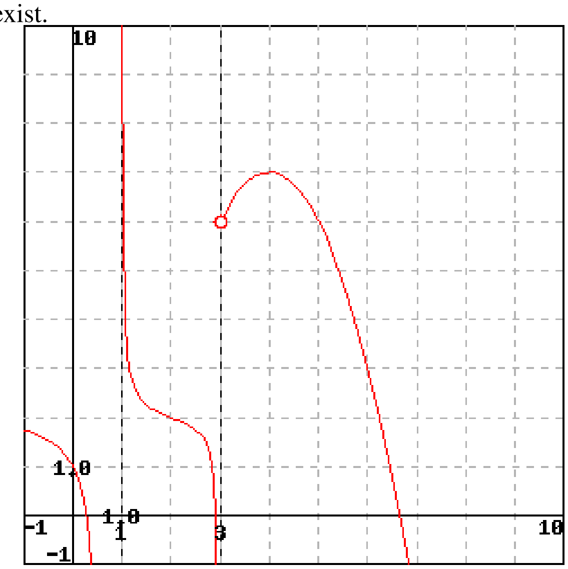
The graph of $y = F(x)$.

18. (1 pt) **Problems/setM151_02_02_Numerical_Graphical_Limits-/2.2.45.pg**

From Rogawski ET section 2.2, exercise 45.

Determine the one or two-sided limits of $f(x)$ at $c = 1$ and $c = 3$ for the function shown in figure.

Enter **inf** for ∞, **-inf** for $-\infty$, and **DNE** if the limit does not exist.



$\lim_{x\to 1-} f(x) =$ ___

$\lim_{x\to 1+} f(x) =$ ___

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

$\lim_{x\to 3-} f(x) =$ ___

$\lim_{x\to 3+} f(x) =$ ___

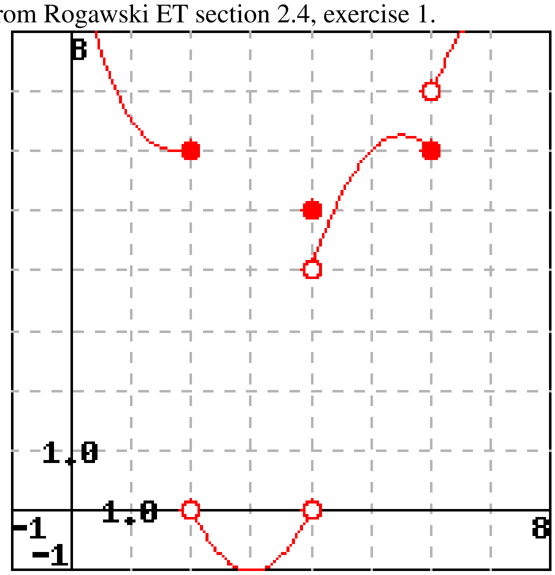
$\lim_{x\to 3} f(x) =$ ___

1. **(1 pt) Problems/setM151_02_04_Limits_and_Continuity/2.4.pq5.pg**
From Rogawski ET section 2.4, exercise PQ5.

Select True or False, depending on whether the statement is true or false.

? 1. If $f(x)$ and $g(x)$ are continuous at $x=a$, then $f(x)/g(x)$ is continuous at $x=a$.
? 2. If the left- and right-hand limits of $f(x)$ as $x \to a$ exist, then f has a removable discontinuity at $x=a$.
? 3. $f(x)$ is continuous at $x=a$ if the left- and right-hand limits of $f(x)$ as $x \to a$ exist and are equal.

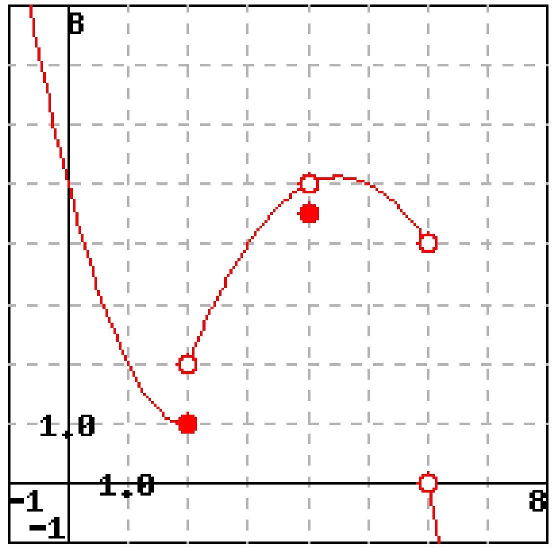
2. **(1 pt) Problems/setM151_02_04_Limits_and_Continuity/2.4.1.pg**
From Rogawski ET section 2.4, exercise 1.



State whether the function shown in the figure is left-continuous, right-continuous, or neither at the following points:

? 1. at $x=6$
? 2. at $x=4$
? 3. at $x=2$

3. **(1 pt) Problems/setM151_02_04_Limits_and_Continuity/2.4.3.pg**
From Rogawski ET section 2.4, exercise 3.



(a) At which point c does $f(x)$ have a removable discontinuity?
$c =$ ____

(b) What value should be assigned to $f(c)$ to make f continuous at $x=c$?
Assign $f(c) =$ ____

4. **(1 pt) Problems/setM151_02_04_Limits_and_Continuity/2.4.17.pg**
From Rogawski ET section 2.4, exercise 17.

Determine the point(s) at which the function $f(x) = \frac{1}{x}$ is discontinuous and state the type of discontinuity: removable, jump, infinite, or none of these.

$x =$ ____ *Hint: If more than one point, separate each with a comma.*

? 1. Choose the type

5. **(1 pt) Problems/setM151_02_04_Limits_and_Continuity/2.4.19.pg**
From Rogawski ET section 2.4, exercise 19.

Determine the point(s) at which the function $f(x) = \frac{x+3}{|x+4|}$ is discontinuous and state the type of discontinuity: removable, jump, infinite, or none of these.

$x =$ ____ *Hint: If more than one point, separate each with a comma.*

? 1. Choose the type

6. **(1 pt) Problems/setM151_02_04_Limits_and_Continuity/2.4.23.pg**
From Rogawski ET section 2.4, exercise 23.

Determine the point(s) at which the function $f(x) = \frac{1}{x^2-64}$ is discontinuous and state the type of discontinuity: removable, jump, infinite, or none of these.

$x =$ ____ *Hint: If more than one point, separate each with a comma.*

? 1. Choose the type

7. (1 pt) Problems/setM151_02_04_Limits_and_Continuity/2.4.25.pg
From Rogawski ET section 2.4, exercise 25.

Enter T or F depending on whether the statement is true or false. (You must enter T or F – True and False will not work.)

___1. The function $f(x) = 3 \cdot x^{\frac{3}{2}} - 9 \cdot x^3$ is right continuous at $x = 0$.

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:
The function $f(x) = 3 \cdot x^{\frac{3}{2}} - 9 \cdot x^3$ is continuous for $x > 0$. At $x = 0$ it is right-continuous. (It is not defined for $x < 0$).

8. (1 pt) Problems/setM151_02_04_Limits_and_Continuity/2.4.27.pg
From Rogawski ET section 2.4, exercise 23.

Determine the point(s) at which the function $f(x) = \frac{1-2x}{x^2-10x+9}$ is discontinuous and state the type of discontinuity: removable, jump, infinite, or none of these.

$x =$ ___ *Hint: If more than one point, separate each with a comma.*

[?] 1. Choose the type

9. (1 pt) Problems/setM151_02_04_Limits_and_Continuity/2.4.29.pg
From Rogawski ET section 2.4, exercise 29.

Determine the point(s) at which the function $f(x) = \frac{x^2-16x+60}{x-10}$ is discontinuous and state the type of discontinuity: removable, jump, infinite, or none of these.

$x =$ ___ *Hint: If more than one point, separate each with a comma.*

[?] 1. Choose the type

10. (1 pt) Problems/setM151_02_04_Limits_and_Continuity/2.4.67.pg
From Rogawski ET section 2.4, exercise 67.

Evaluate the limit $\lim\limits_{x\to\frac{\pi}{8}} \tan(24 \cdot x)$.

$\lim\limits_{x\to\frac{\pi}{8}} \tan(24 \cdot x) =$ ________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:
$\lim_{x\to\frac{\pi}{8}} \tan(24 \cdot x) = \tan(24 \cdot \frac{\pi}{8}) = 0$

11. (1 pt) Problems/setM151_02_04_Limits_and_Continuity/2.4.73.pg
From Rogawski ET section 2.4, exercise 73.

Evaluate the limit $\lim\limits_{x\to 2} 10^{x^2-4\cdot x}$.

$\lim\limits_{x\to 2} 10^{x^2-4\cdot x} =$ ________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:
$\lim_{x\to 2} 10^{x^2-4\cdot x} = 10^{2^2-4\cdot 2} = 0.0001$.

12. (1 pt) Problems/setM151_02_04_Limits_and_Continuity/2.4.77.pg
From Rogawski ET section 2.4, exercise 77.

Evaluate the limit $\lim\limits_{x\to 4} \sin^{-1}(\frac{x}{4})$.

$\lim\limits_{x\to 4} \sin^{-1}(\frac{x}{4}) =$ ________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:
$\lim_{x\to 4} sin^{-1}(\frac{x}{4}) = sin^{-1}(\frac{4}{4}) = \frac{\pi}{2}$.

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1. **(1 pt) Problems/setM151_03_01_Derivative_Def/3.1.PQ3.pg**
From Rogawski ET section 3.1, exercise PQ3.

For which value of x is
$\frac{f(x)-f(3)}{x-3} = \frac{f(7)-f(3)}{4}$?
$x =$ ___

---

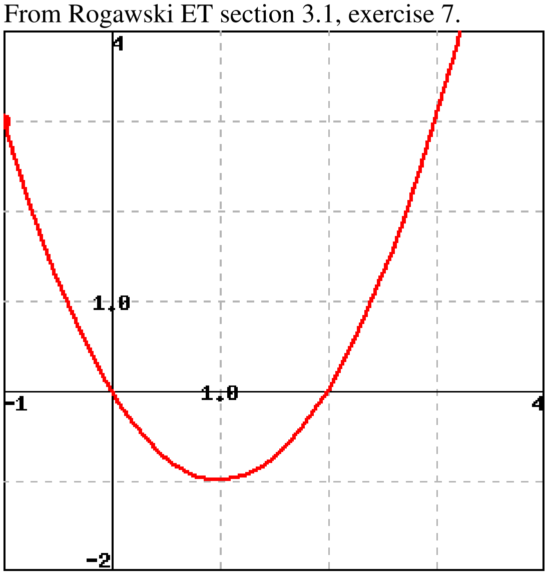
2. **(1 pt) Problems/setM151_03_01_Derivative_Def/3.1.1.pg**
From Rogawski ET section 3.1, exercise 1.

Let $f(x)$ be the function $3x^2 - 9x + 2$. Then the quotient $\frac{f(4+h)-f(4)}{h}$ can be simplified to $ah + b$ for:
$a =$ _____
$b =$ _____

Compute $f'(4)$ by taking the limit as $h \to 0$.
$f'(4) =$ _____

---

3. **(1 pt) Problems/setM151_03_01_Derivative_Def/3.1.7.pg**
From Rogawski ET section 3.1, exercise 7.



Calculate the slope of the secant line through the points on the graph where $x = 1$ and $x = 3$.
slope = ___

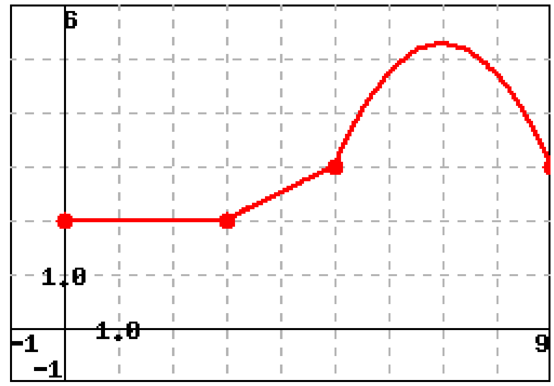
SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:
The slope of the secant line is $\frac{f(3)-f(1)}{3-1} = \frac{3-(-1)}{2} = 2$

---

4. **(1 pt) Problems/setM151_03_01_Derivative_Def/3.1.11.pg**
From Rogawski ET section 3.1, exercise 11.

Let $f(x)$ be the function whose graph is shown below.



Determine $f'(a)$ for $a = 1, 2, 4, 7$.
$f'(1) =$ __________
$f'(2) =$ __________
$f'(4) =$ __________
$f'(7) =$ __________

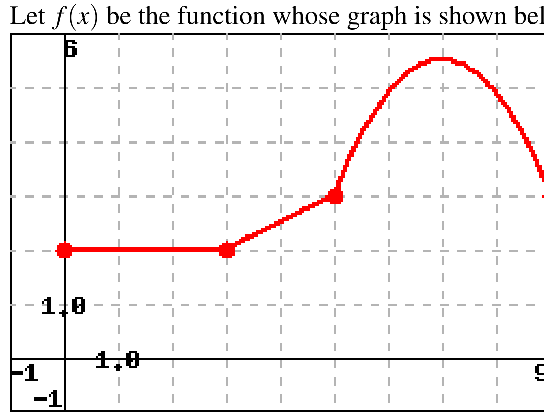
SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Remember that the value of the derivative of f at $x = a$ can be interpreted as the slope of the line tangent to the graph of $y = f(x)$ at $x = a$. From the figure, we see that the graph of $y = f(x)$ is a horizontal line (that is, a line with zero slope) on the interval $0 \le x \le 3$. Accordingly, $f'(1) = f'(2) = 0$. On the interval $3 \le x \le 5$, the graph of $y = f(x)$ is a line of slope 0.5; thus, $f'(4) = 0.5$. Finally, the line tangent to the graph of $y = f(x)$ at $x = 7$ is horizontal, so $f'(7) = 0$.

---

5. **(1 pt) Problems/setM151_03_01_Derivative_Def/3.1.13.pg**
From Rogawski ET section 3.1, exercise 13.

Let $f(x)$ be the function whose graph is shown below.



Which is larger?

- A. $f'(7.5)$
- B. $f'(8.5)$

Note: *Don't just guess. You are allowed only one attempt to answer for credit.*

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: The line tangent to the graph of $y = f(x)$ at $x = 7.5$ has a larger slope than the line tangent to the graph of $y = f(x)$ at $x = 8.5$. Therefore, $f'(7.5)$ is larger than $f'(8.5)$.

---

6. **(1 pt) Problems/setM151_03_01_Derivative_Def/3.1.15.pg**
From Rogawski ET section 3.1, exercise 15.

Use the definition of the derivative to find the derivative of: $f(x) = 12x - 5$.
$f'(x) =$ __________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:
$\lim\limits_{h\to 0} \frac{f(x+h)-f(x)}{h} = \lim\limits_{h\to 0} \frac{12x+12h-5-12x+5}{h} = \lim\limits_{h\to 0} \frac{12h}{h} = \lim\limits_{h\to 0} 12 = 12$

---

7. **(1 pt) Problems/setM151_03_01_Derivative_Def/3.1.17.pg**
From Rogawski ET section 3.1, exercise 17.

Use the definition of the derivative to find the derivative of: $f(t) = -9 - 6t$.
$f'(t) =$ __________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:
$\lim\limits_{h\to 0} \frac{f(t+h)-f(t)}{h} = \lim\limits_{h\to 0} \frac{(-9-6t-6h)-(-9-6t)}{h} = \lim\limits_{h\to 0} \frac{-6h}{h} = \lim\limits_{h\to 0} -6 = -6$

---

8. **(1 pt) Problems/setM151_03_01_Derivative_Def/3.1.19.pg**
From Rogawski ET section 3.5, exercise 19.

Let $f(x) = \frac{1}{x}$. Compute the difference quotient for $f(x)$ at $a = -2$ with $h = 0.2$

The difference quotient = __________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

The difference quotient is $\frac{f(x+h)-f(x)}{h} = \frac{\frac{1}{-2+0.2} - \frac{1}{-2}}{0.2} = -0.277778$.

---

9. **(1 pt) Problems/setM151_03_01_Derivative_Def/3.1.23.pg**
From Rogawski ET section 3.1, exercise 23.

Let $f(x) = 9x^2 + 4x + 8$.
Then using the limit definition of the derivative,
$\lim\limits_{h\to 0} \frac{f(6+h)-f(6)}{h}$ can be simplified to $rh + s$ for:
$r =$ _____
$s =$ _____

Taking the limit as $h \to 0$, compute the derivative at $x = 6$.
$f'(6) =$ __________

Find an equation of the tangent line at $x = 6$.
$y =$ __________

---

10. **(1 pt) Problems/setM151_03_01_Derivative_Def/3.1.25.pg**
From Rogawski ET section 3.1, exercise 25.

Let $f(x) = x^3$.

Then using the limit definition of the derivative,
$\lim\limits_{h\to 0} \frac{f(10+h)-f(10)}{h}$ can be simplified to $rh^2 + sh + t$ for:
$r =$ _____
$s =$ _____
$t =$ _____

Taking the limit as $h \to 0$, compute the derivative at $x = 10$.
$f'(10) =$ __________

Find an equation of the tangent line at $x = 10$.
$y =$ __________

---

11. **(1 pt) Problems/setM151_03_01_Derivative_Def/3.1.29.pg**
From Rogawski ET section 3.1, exercise 29.

Let $f(x) = \frac{1}{9x}$.
Compute the derivative at $x = 2$ using the limit definition.
$f'(2) =$ _____

Find an equation of the tangent line at $x = 2$.
$y =$ __________

---

12. **(1 pt) Problems/setM151_03_01_Derivative_Def/3.1.31.pg**
From Rogawski ET section 3.1, exercise 31.

Let $f(x) = x - 9$.
Compute the derivative at $x = -9$ using the limit definition.
$f'(-9) =$ _____

Find an equation of the tangent line at $x = -9$.
$y =$ __________

---

13. **(1 pt) Problems/setM151_03_01_Derivative_Def/3.1.33.pg**
From Rogawski ET section 3.1, exercise 33.

Let $f(x) = \frac{1}{x+8}$.
Compute the derivative at $x = -7$ using the limit definition.
$f'(-7) =$ _____

Find an equation of the tangent line at $x = -7$.
$y =$ __________

---

14. **(1 pt) Problems/setM151_03_01_Derivative_Def/3.1.39.pg**
From Rogawski ET section 3.1, exercise 39.

Let $f(x) = \frac{1}{\sqrt{4x}}$.
Compute the derivative at $x = 36$ using the limit definition.
$f'(36) =$ _____

Find an equation of the tangent line at $x = 36$.
$y =$ __________

---

15. **(1 pt) Problems/setM151_03_01_Derivative_Def/3.1.48.pg**
From Rogawski ET section 3.1, exercise 48.

Below is an "oracle" function. An oracle function is a function presented interactively. When you type in a t value, and press the –f–> button the value $f(t)$ appears in the right hand window. There are three lines, so you can calculate three different values of the function at one time.

Use the oracle function to calculate a few values near 0.89. Use these values to calculate a few difference quotients of $f(x)$.

Then estimate $f'(0.89)$ by taking an average of difference quotients at h and $-h$.

$f'(0.89)$ = ________

The java Script calculator was displayed here

Remember this technique for finding velocities. Later we will use the same method to find the derivative of functions such as $f(t)$.

---

16. **(1 pt) Problems/setM151_03_01_Derivative_Def/3.1.53.pg**

From Rogawski ET section 3.1, exercise 53.

The limit below represents a derivative $f'(a)$. Find $f(x)$ and a.

$$\lim_{h\to 0} \frac{(3+h)^4-81}{h}$$

$f(x) =$ ________

$a =$ ________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: The difference quotient

$$\frac{(3+h)^4-81}{h}$$

has the form

$$\frac{f(a+h)-f(a)}{h}$$

where $f(x) = x^4$ and $a = 3$.

---

17. **(1 pt) Problems/setM151_03_01_Derivative_Def/3.1.55.pg**

From Rogawski ET section 3.1, exercise 55.

The limit below represents a derivative $f'(a)$. Find $f(x)$ and a.

$$\lim_{h\to 0} \frac{\cos(\pi+h)+1}{h}$$

$f(x) =$ ________

$a =$ ________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: The difference quotient

$$\frac{\cos(\pi+h)+1}{h}$$

has the form

$$\frac{f(a+h)-f(a)}{h}$$

where $f(x) = \cos(x)$ and $a = \pi$.

---

18. **(1 pt) Problems/setM151_03_01_Derivative_Def/3.1.57.pg**

From Rogawski ET section 3.1, exercise 57.

The limit below represents a derivative $f'(a)$. Find $f(x)$ and a.

$$\lim_{h\to 0} \frac{5^{2+h}-25}{h}$$

$f(x) =$ ________

$a =$ ________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: The difference quotient

$$\frac{5^{2+h}-25}{h}$$

has the form

$$\frac{f(a+h)-f(a)}{h}$$

where $f(x) = 5^x$ and $a = 2$.

1. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.PQ1.pg**
From Rogawski ET section 3.2, exercise PQ1.

What is the slope of the tangent line through the point $(2, f(2))$ if f is a function such that $f'(x) = x^2$?

Answer: ___

2. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.PQ2.pg**
From Rogawski ET section 3.2, exercise PQ2.

Suppose $f'(-3) = 2$ and $g'(-3) = 6$.

(a) Then $(f-g)'(-3) =$ ___

(b) Then $(8f+10g)'(-3) =$ ___

(c) Can we evaluate $(fg)'(-3)$ using the information given and the rules presented in this section?

- A. No
- B. Yes

3. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.PQ3.pg**
From Rogawski ET section 3.2, exercise PQ3.

To which of the following does the Power Rule apply?

- A. $f(x) = e^x$
- B. $f(x) = x^\pi$
- C. $f(x) = \sqrt[9]{x}$
- D. $f(x) = x^{(2)}$
- E. $f(x) = 2^e$
- F. $f(x) = \pi^x$

4. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.1.pg**
From Rogawski ET section 3.2, exercise 1.

Let $f(x) = 15x - 11$.

Compute $f'(x)$ using the limit definition.

$f'(x) =$ ___

5. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.3.pg**
From Rogawski ET section 3.2, exercise 3.

Let $f(x) = 11 - 2x^3$.

Compute $f'(x)$ using the limit definition.

$f'(x) =$ ___

6. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.5.pg**
From Rogawski ET section 3.2, exercise 5.

Let $f(x) = \frac{1}{x}$.

Compute $f'(x)$ using the limit definition.

$f'(x) =$ ___

7. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.7.pg**
From Rogawski ET section 3.2, exercise 7.

Let $f(x) = 7\sqrt{x}$.

Compute $f'(x)$ using the limit definition.

$f'(x) =$ ___

8. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.9.pg**
From Rogawski ET section 3.2, exercise 9.

Use the Power Rule to compute the derivative.

$\frac{d}{dx}x^5|_{x=-1} =$ ___

9. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.11.pg**
From Rogawski ET section 3.2, exercise 11.

Use the Power Rule to compute the derivative.

$\frac{d}{dt}t^{2/3}|_{t=3} =$ ___

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:
$\frac{d}{dt}t^{2/3} = \frac{2}{3}t^{-1/3}$, so $\frac{d}{dt}t^{2/3}|_{t=3} = \frac{2}{3}(3)^{-1/3} = \frac{2}{3\sqrt[3]{3}}$.

10. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.13.pg**
From Rogawski ET section 3.2, exercise 13.

Use the power rule to compute the derivative.

$\frac{d}{dx}x^{0.5} =$ ___

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

$$\frac{d}{dx}x^{0.5} = 0.5(x^{0.5-1}) = 0.5x^{-0.5}.$$

11. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.15.pg**
From Rogawski ET section 3.2, exercise 15.

Use the Power Rule to compute the derivative.

$\frac{d}{dt}t^{\sqrt{3}} =$ ___

12. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.17.pg**
From Rogawski ET section 3.2, exercise 17.

Let $f(x) = x^3$.

Compute the derivative at $x = 1$.

$f'(1) =$ ___

Find an equation of the tangent line at $x = 1$.

$y =$ ___

13. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.19.pg**
From Rogawski ET section 3.2, exercise 19.

Let $f(x) = 3\sqrt{x} + 9x$.

Compute the derivative at $x = 25$.

$f'(25) =$ ___

Find an equation of the tangent line at $x = 25$.

$y =$ ___

14. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.23.pg**
From Rogawski ET section 3.2, exercise 23.

Calculate the derivative of the function: $f(x) = 3x^3 + 4x^2 + 5x - 5$
$f'(x) =$ _____

15. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.25.pg**
From Rogawski ET section 3.2, exercise 25.

Calculate the derivative of the function: $f(x) = 3x^3 + (-4)x^{-1}$
$f'(x) =$ _____

16. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.27.pg**
From Rogawski ET section 3.2, exercise 27.

Calculate the derivative of the function: $g(z) = 2z^{-3} + 2z^2 - 4z + 6$
$g'(z) =$ _____

17. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.29.pg**
From Rogawski ET section 3.2, exercise 29.

Calculate the derivative of the function: $f(s) = \sqrt[6]{s} + \sqrt[8]{s}$
$f'(s) =$ _____

18. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.31.pg**
From Rogawski ET section 3.2, exercise 31.

Calculate the derivative of the function: $f(x) = (x-3)^3$
Hint: Expand.
$f'(x) =$ _____

19. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.33.pg**
From Rogawski ET section 3.2, exercise 33.

Calculate the derivative of the function: $P(z) = (3z+7)(8z-3)$

$P'(z) =$ _____

20. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.35.pg**
From Rogawski ET section 3.2, exercise 35.

Calculate the derivative of the function: $g(x) = e^{-5}$

$g'(x) =$ _____

21. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.39.pg**
From Rogawski ET section 3.2, exercise 39.

Let $f(x) = \frac{8}{x^5}$.

Calculate the indicated derivative.
$f'(4) =$ _____

22. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.41.pg**
From Rogawski ET section 3.2, exercise 41.

Let $T = 3C^{\frac{8}{3}}$.
Calculate the indicated derivative.

$\frac{dT}{dC}|_{C=5} =$ __________

23. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.55.pg**
From Rogawski ET section 3.2, exercise 55.

Find all values of x where the tangent lines to $y = x^3$ and $y = x^4$ are parallel.

$x =$ __________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Let $f(x) = x^3$ and let $g(x) = x^4$. The two graphs have parallel tangent lines at all x where $f'(x) = g'(x)$.

$$f'(x) = g'(x)$$

$$3x^2 = 4x^3$$

$$3x^2 - 4x^3 = 0$$

$$x^2(3-4x) = 0$$

hence, $x = 0$ or $x = \frac{3}{4}$.

24. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.57.pg**
From Rogawski ET section 3.2, exercise 57.

Determine coefficients a and b such that $p(x) = x^2 + ax + b$ satisfies $p(1) = -9$ and $p'(1) = -2$.

$a =$ __________
$b =$ __________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Let $p(x) = x^2 + ax + b$ satisfy $p(1) = -9$ and $p'(1) = -2$. Since $p'(x) = 2x + a$, this implies $-9 = p(1) = 1 + a + b$ and $-2 = p'(1) = 2 + a$; i.e., $a = -4$ and $b = -6$.

25. **(1 pt) Problems/setM151_03_02_Derivative_as_Function/3.2.77.pg**
From Rogawski ET section 3.2, exercise 77.

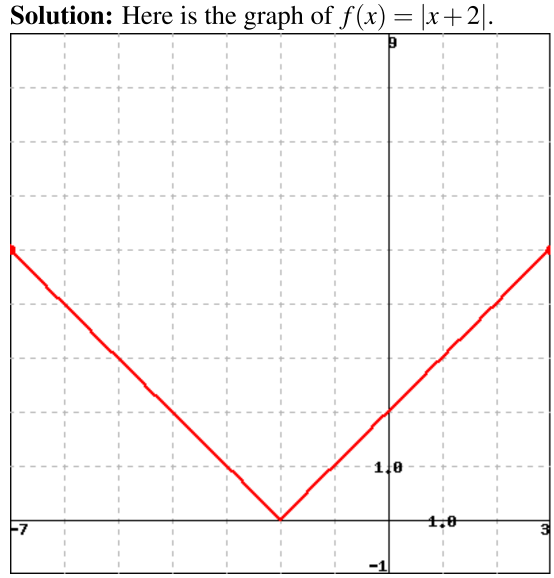
Find the points c (if any) such that $f'(c)$ does not exist.

$$f(x) = |x+2|$$

$c =$ __________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Here is the graph of $f(x) = |x+2|$.



Its derivative does not exist at $x = -2$. At that value of x there is a sharp point.

1. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.1.pg**
From Rogawski ET section 3.7, exercise 1.
Given the following functions: $f(u) = u^{5/2}$ and $g(x) = x^6 + 1$. Find:
$f(g(x)) =$ ______
$f'(u) =$ ______
$f'(g(x)) =$ ______
$g'(x) =$ ______
$(f \circ g)'(x) =$ ______

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

$f(g(x))$	$f'(u)$	$f'(g(x))$	$g'(x)$	$(f \circ g)'$
$(x^6+1)^{\frac{5}{2}}$	$\frac{5}{2}u^{\frac{3}{2}}$	$\frac{5}{2}(x^6+1)^{\frac{3}{2}}$	$6x^5$	$15x^5(x^6+1)^{\frac{3}{2}}$

2. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.3.pg**
From Rogawski ET section 3.7, exercise 3.
Given the following functions: $f(u) = \tan(u)$ and $g(x) = x^3$. Find:
$f(g(x)) =$ ______
$f'(u) =$ ______
$f'(g(x)) =$ ______
$g'(x) =$ ______
$(f \circ g)'(x) =$ ______

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

$f(g(x)$	$f'(u)$	$f'(g(x))$	$g'(x)$	$(f \circ g)'$
$tan(x^3)$	$sec^2 u$	$sec^2(x^3)$	$3x^2$	$3x^2 sec^2(x^3)$

3. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.5.pg**
From Rogawski ET section 3.7, exercise 5.
Let $y = (x + 2\cos(x))^2$.
Find $g(x)$ and $f(x)$ so that $y = (f \circ g)(x)$, and compute the derivative using the Chain Rule.
$f(x) =$ ______
$g(x) =$ ______
$(f \circ g)'(x) =$ ______
SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

Let $f(x) = x^2$, $g(x) = x + 2\cos(x)$, and $(f \circ g)(x) = (x + 2\cos(x))^2$. Then
$\frac{dy}{dx} = f'(g(x))g'(x) = 2(x + 2\cos(x))^1(1 - 2\sin(x))$.

4. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.7.pg**
From Rogawski ET section 3.7, exercise 7.
Calculate $\frac{d}{dx}\cos(u)$ for the following choices of $u(x)$:
$u(x) = 2 - x^2$, $\frac{d}{dx}\cos(u(x)) =$ ______

$u(x) = x^{-5}$, $\frac{d}{dx}\cos(u(x)) =$ ______

$u(x) = \tan(x)$, $\frac{d}{dx}\cos(u(x)) =$ ______

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:
(a) $cos(u(x)) = cos(2 - x^2)$.
$\frac{d}{dx}cos(u(x)) = -sin(u(x)) \cdot u'(x) = -sin(2 - x^2)(-2x) = 2x sin(2 - x^2)$.
(b) $cos(u(x)) = cos(x^{-5})$.
$\frac{d}{dx}cos(u(x)) = -sin(u(x)) \cdot u'(x) = -sin(x^{-5})(-5x^{-6}) = 5x^{-6} sin(x^{-5})$.
(c) $cos(u(x)) = cos(tanx)$.
$\frac{d}{dx}cos(u(x)) = -sin(u(x)) \cdot u'(x) = -sin(tanx)(sec^2 x)$.

5. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.9.pg**
From Rogawski ET section 3.7, exercise 9.
Use the General Power Rule to find the derivative.

$$y = \left(x^5 + 5\right)^6$$

.

$y' =$ ______
SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Recall the General Power Rule:
$\frac{d}{dx}g(x)^n = n(g(x))^{n-1}g'(x)$
In this case, $g(x) = x^5 + 5$ and therefore $g'(x) = 5x^4$. Thus, $y' = 6\left(x^5 + 5\right)^5 \cdot 5x^4$.

6. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.11.pg**
From Rogawski ET section 3.7, exercise 11.
Use the General Power Rule to find the derivative.

$$y = \sqrt{14x - 4}$$

.

$y' =$ ______

7. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.13.pg**
From Rogawski ET section 3.7, exercise 13.

Use the Generalized e-to-the-x Rule to find the derivative.

$$y = e^{12-x^2}$$

$y' =$ ________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Recall the General Power Rule:
$\frac{d}{dx}e^{g(x)} = g'(x)e^{g(x)}$
In this case, $g(x) = 12 - x^2$ and therefore $g'(x) = -2x$. Thus, $y' = -2xe^{12-x^2}$.

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8. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.15.pg**
From Rogawski ET section 3.7, exercise 15.

Let $f(u) = \csc(u)$ and $g(x) = 91x - 43$.
Find the derivative of $f \circ g$.

$(f \circ g)'(x) =$ ________

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9. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.17.pg**
From Rogawski ET section 3.7, exercise 17.

Let $f(u) = e^u$ and $g(x) = x + x^{-4}$.
Find the derivative of $f \circ g$.

$(f \circ g)'(x) =$ ________

---

10. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.19.pg**
From Rogawski ET section 3.7, exercise 19.

Let $f(u) = \csc(u)$ and $g(x) = 2x^2 + 3x + 11$.
Find the derivatives of $f(g(x))$ and $g(f(x))$.

$\frac{d}{dx}f(g(x)) =$ ________

$\frac{d}{dx}g(f(x)) =$ ________

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11. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.21.pg**
From Rogawski ET section 3.7, exercise 21.

Use the Chain Rule to find the derivative.

$$y = \sin\left(x^6\right)$$

$y' =$ ________

---

12. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.25.pg**
From Rogawski ET section 3.7, exercise 25.

Use the Chain Rule to find the derivative.

$$y = (1t^2 + 5t + 4)^{-7/2}$$

$y' =$ ____________

---

13. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.29.pg**
From Rogawski ET section 3.7, exercise 29.

Use the Chain Rule to find the derivative.

$$y = \sec^8\left(e^{6x}\right)$$

$y' =$ ____________

---

14. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.33.pg**
From Rogawski ET section 3.7, exercise 33.

Use the Chain Rule to find the derivative.

$$y = e^{\frac{9}{x}}$$

$y' =$ ____________

---

15. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.35.pg**
From Rogawski ET section 3.7, exercise 35.

Find the derivative of using the appropriate rule or combination of rules.

$$y = \tan(8x + 2)$$

$y' =$ ________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: For this, we use the Chain Rule with $f(x) = tanx$ and $g(x) = 8x + 2$.
$f'(x) = sec^2 x$
$g'(x) = 8$ and thus
$y' = f'(g(x)) * g'(x) = 8sec^2(8x + 2)$.

---

16. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.37.pg**
From Rogawski ET section 3.7, exercise 37.

Find the derivative using the appropriate rule or combination of rules.

$$y = 3x\tan(8 + 4x)$$

$y' =$ ____________

---

17. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.39.pg**
From Rogawski ET section 3.7, exercise 39.

Find the derivative using the appropriate rule or combination of rules.

$$y = (4x + 25)^{\frac{1}{2}}$$

$y' =$ ________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: For this, we use the Chain Rule with $f(x) = x^{\frac{1}{2}}$ and $g(x) = 4x + 25$.
$f'(x) = \frac{1}{2}x^{-\frac{1}{2}}$
$g'(x) = 4$ and thus
$y' = f'(g(x)) * g'(x) = 2(4x+25)^{-0.5}$.

---

18. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.43.pg**
From Rogawski ET section 3.7, exercise 43.
Find the derivative using the appropriate rule or combination of rules.

$$y = \sqrt{\sin(9x)\cos(4x)}$$

$y' =$ ______________

---

19. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.49.pg**
From Rogawski ET section 3.7, exercise 49.
Find the derivative using the appropriate rule or combination of rules.

$$y = \sqrt{\cos(x) + \tan(x^9)}$$

$y' =$ ___________________

---

20. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.51.pg**
From Rogawski ET section 3.7, exercise 51.
Find the derivative using the appropriate rule or combination of rules.

$$y = \sec^6(x) + \sec\left(x^6\right)$$

$y' =$ ______________

---

21. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.53.pg**
From Rogawski ET section 3.7, exercise 53.
Find the derivative of using the appropriate rule or combination of rules.

$$y = \sqrt{\frac{z+4}{z-7}}$$

$y' =$ ___________________

---

22. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.57.pg**
From Rogawski ET section 3.7, exercise 57.
Find the derivative using the appropriate rule or combination of rules.

$$y = \cot^7\left(x^5\right)$$

$y' =$ ______________

---

23. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.59.pg**
From Rogawski ET section 3.7, exercise 59.
Find the derivative of using the appropriate rule or combination of rules.

$$y = \left(1 + \left(x^3 + 6\right)^6\right)^5$$

$y' =$ ______________

---

24. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.63.pg**
From Rogawski ET section 3.7, exercise 63.
Find the derivative of using the appropriate rule or combination of rules.

$$y = \left(4e^{9x} + 9e^{-4x}\right)^5$$

$y' =$ ______________

---

25. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.65.pg**
From Rogawski ET section 3.7, exercise 65.
Find the derivative using the appropriate rule or combination of rules.

$$y = \cos\left(te^{-7t}\right)$$

$y' =$ ___________________

---

26. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.67.pg**
From Rogawski ET section 3.7, exercise 67.
Find the derivative using the appropriate rule or combination of rules.

$$y = e^{\left(x^2+7x+1\right)^2}$$

$y' =$ ______________

27. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.71.pg**
From Rogawski ET section 3.7, exercise 71.

Find the derivative of using the appropriate rule or combination of rules.

$$y = \sqrt{kx+d}$$

$y' =$ ____________________

28. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.73.pg**
From Rogawski ET section 3.7, exercise 73.

Compute $\frac{df}{dx}$
if $\frac{df}{du} = -7$ and $\frac{du}{dx} = 6$.
$\frac{df}{dx} =$ __________

29. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.77.pg**
From Rogawski ET section 3.7, exercise 77.

Compute the derivative of $h(\sin(x))$ at $x = \pi/6$, assuming $h'(0.5) = 12$.
Answer: __________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:
$\frac{d}{dx}h(sinx) = h'(sinx)\cdot(sinx)' = h'(sinx)cosx$
So,
$\frac{d}{dx}h(sinx)|_{x=\frac{\pi}{6}} = h'(sin\frac{\pi}{6})cos\frac{\pi}{6} = h'(0.5)\frac{\sqrt{3}}{2} = 6\sqrt{3}.$

30. **(1 pt) Problems/setM151_03_07_Chain_Rule/3.7.89.pg**
From Rogawski ET section 3.7, exercise 89.

Compute the second derivative of $\sin(g(x))$ at $x = 3$, assuming that $g(3) = \pi/4, g'(3) = 4$, and $g''(3) = 9$.

Answer: __________

1. **(1 pt) Problems/setM151_03_08_Implicit_Differentiation/3.8.3.pg**
From Rogawski ET section 3.8, exercise 3.

Differentiate the expression x^2y^4 with respect to x. (Use D for $\frac{dy}{dx}$).

The result is ______

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Assuming that y depends on x, then $\frac{d}{dx}(x^2y^4) = x^2 \cdot 4y^{4-1}D + y^4 \cdot 2x^{2-1} = 4x^2y^3D + 2x^1y^4$.

2. **(1 pt) Problems/setM151_03_08_Implicit_Differentiation/3.8.5.pg**
From Rogawski ET section 3.8, exercise 5.

Differentiate the expression $\left(x^2+y^2\right)^5$ with respect to x. (Use D for $\frac{dy}{dx}$).

The result is ______

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Assuming that y depends on x, then by the chain rule $\frac{d}{dx}(\left(x^2+y^2\right)^5) = 5\left(x^2+y^2\right)^4(2x+2yD)$.

3. **(1 pt) Problems/setM151_03_08_Implicit_Differentiation/3.8.7.pg**
From Rogawski ET section 3.8, exercise 7.

Differentiate the expression $z+z^7$ with respect to x. (Use D for $\frac{dz}{dx}$).

The result is ______

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Assuming that z depends on x, then by the chain rule $\frac{d}{dx}(z+z^7) = D + D \cdot 7z^6$.

4. **(1 pt) Problems/setM151_03_08_Implicit_Differentiation/3.8.9.pg**
From Rogawski ET section 3.8, exercise 9.

Calculate the derivative of y with respect to x.

$3y^5 + 9x^4 = 7$

$\frac{dy}{dx} =$ ______

5. **(1 pt) Problems/setM151_03_08_Implicit_Differentiation/3.8.11.pg**
From Rogawski ET section 3.8, exercise 11.

Calculate the derivative of y with respect to x.

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

$\frac{dy}{dx} =$ ____________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

Let $x^2y+2xy^2 = x+y$. Then

$2x^{2-1}y + x^2\frac{dy}{dx} + 2^2xy^{2-1}\frac{dy}{dx} + 2y^2 = 1 + \frac{dy}{dx}$

whence

$$\frac{dy}{dx} = \frac{2yx+2y^2-1}{1-x^2-4xy}.$$

6. **(1 pt) Problems/setM151_03_08_Implicit_Differentiation/3.8.13.pg**
From Rogawski ET section 3.8, exercise 13.

Calculate the derivative of y with respect to x.

$x^2y + y^3 - 10x = 60$

$\frac{dy}{dx} =$ ____________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

We apply the product rule and the chain rule together:

$2x^{2-1}y + x^2\frac{dy}{dx} + 3y^{3-1}\frac{dy}{dx} - 10 = 0$

$(3y^2+x^2)\frac{dy}{dx} = 10 - 2xy$

$$\frac{dy}{dx} = \frac{10-2xy}{3y^2+x^2}$$

7. **(1 pt) Problems/setM151_03_08_Implicit_Differentiation/3.8.17.pg**
From Rogawski ET section 3.8, exercise 17.

Calculate the derivative of y with respect to x.

$y^{\frac{-3}{2}} + x^{\frac{3}{2}} = 1$

$\frac{dy}{dx} =$ ______

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

Let $y^{\frac{-3}{2}} + x^{\frac{3}{2}} = 1$. Then

$\frac{-3}{2}y^{\frac{-3-2}{2}} + \frac{3}{2}x^{\frac{3-2}{2}} = 0$, whence

$\frac{dy}{dx} = x^{\frac{1}{2}}y^{\frac{5}{2}}$

8. **(1 pt) Problems/setM151_03_08_Implicit_Differentiation/3.8.21.pg**
From Rogawski ET section 3.8, exercise 21.

Calculate the derivative of y with respect to x.

$1y + \frac{x}{y^1} = 1$

$\frac{dy}{dx} =$ ______

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

Let $1y + \frac{x}{y^1} = 1$. Then

$1\frac{dy}{dx} + \frac{1}{y^1} - \frac{1x}{y^2}\frac{dy}{dx} = 0,$

whence

$\frac{1}{y^1} = (\frac{1x}{y^2}+1)\frac{dy}{dx}$ whence
$\frac{1}{y^1} = [1(\frac{x+y^2}{y^2})]\frac{dy}{dx}$
and finally
$\frac{dy}{dx} = \frac{y}{1(x+y^2)}$.

---

9. **(1 pt) Problems/setM151_03_08_Implicit_Differentiation/3.8.23.pg**
From Rogawski ET section 3.8, exercise 23.

Calculate the derivative of y with respect to x.

$\sin(x+y) = 4x+\cos(y)$
$\frac{dy}{dx} =$ ____________________

---

10. **(1 pt) Problems/setM151_03_08_Implicit_Differentiation/3.8.25.pg**
From Rogawski ET section 3.8, exercise 25.

Calculate the derivative of y with respect to x.

$xe^y = 3xy+4y^4$
$\frac{dy}{dx} =$ ____________________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

To solve for $\frac{dy}{dx}$, we must think of y as a function of x and differentiate both sides of the equation, using the chain rule where appropriate:

$$e^y + xe^y\frac{dy}{dx} = 3y+3x\frac{dy}{dx}+16y^3\frac{dy}{dx}$$

Now, lets simplify and move the terms with a $\frac{dy}{dx}$ to the right, and keep the terms without a $\frac{dy}{dx}$ to the left:

$e^y - 3y = (3x+16y^3-xe^y)\frac{dy}{dx}$

Finally, we can solve for $\frac{dy}{dx}$:
$\frac{dy}{dx} = \frac{e^y-3y}{3x+16y^3-xe^y}$

---

11. **(1 pt) Problems/setM151_03_08_Implicit_Differentiation/3.8.27.pg**
From Rogawski ET section 3.8, exercise 27.

Find $\frac{dy}{dx}$ at the point $(2,-3)$.

$(x+3)^2-4(3y+2)^2 = -171$
$\frac{dy}{dx}\big|_{(2,-3)} =$ __________

---

12. **(1 pt) Problems/setM151_03_08_Implicit_Differentiation/3.8.29.pg**
From Rogawski ET section 3.8, exercise 29.

Find an equation of the tangent line at the point $(2,4)$.

$$xy-7y = -20$$

$y =$ __________

---

13. **(1 pt) Problems/setM151_03_08_Implicit_Differentiation/3.8.31.pg**
From Rogawski ET section 3.8, exercise 31.

Find an equation of the tangent line at the point $(1,1)$.

$$6x^{\frac{2}{3}}+2y^{\frac{2}{3}} = 8$$

$y =$ __________

---

14. **(1 pt) Problems/setM151_03_08_Implicit_Differentiation/3.8.41.pg**
From Rogawski ET section 3.8, exercise 41.

Differentiate the equation $x^5+5xy^3 = 13$ with respect to the variable t and express $\frac{dy}{dt}$ in terms of $\frac{dx}{dt}$.
(Use D for $\frac{dx}{dt}$).
$\frac{dy}{dt}$=__________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Let $x^5+5xy^3 = 13$. Then $5x^{5-1}\frac{dx}{dt}+5\cdot 3xy^{3-1}\frac{dy}{dt}+5y^3\frac{dx}{dt} = 0$, whence $\frac{dy}{dt} = \frac{-D\cdot 5x^4-5Dy^3}{5x\cdot 3y^2}$

---

15. **(1 pt) Problems/setM151_03_08_Implicit_Differentiation/3.8.43.pg**
From Rogawski ET section 3.8, exercise 43.

Differentiate the equation $y^7+2xy+x^4 = 0$ with respect to the variable t and express $\frac{dy}{dt}$ in terms of $\frac{dx}{dt}$.
(Use D for $\frac{dx}{dt}$).
$\frac{dy}{dt}$=__________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Let $y^7+2xy+x^4 = 0$. Then $7y^{7-1}\frac{dy}{dt}+2\cdot x\frac{dy}{dt}+2\cdot y\frac{dx}{dt}+4y^{4-1}\frac{dx}{dt} = 0$, whence $\frac{dy}{dt} = \frac{-D\left(4x^3+2y\right)}{2x+7y^6}$

---

1. **(1 pt) Problems/setM151_03_11_Related_Rates/3.11.1.pg**
From Rogawski ET section 3.11, exercise 1.

Consider a rectangular bathtub whose base is 83ft^2.

How fast is the water level rising if water is filling the tub at a rate of 0.1ft^3/min?

Answer: __________

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2. **(2 pts) Problems/setM151_03_11_Related_Rates/3.11.3.pg**
From Rogawski ET section 3.11, exercise 3.

The radius of a circular oil slick expands at a rate of 8 m/min.

(a) How fast is the area of the oil slick increasing when the radius is 25 m?

$\frac{dA}{dt}$ = __________

(b) If the radius is 0 at time $t = 0$, how fast is the area increasing after 2 min?

$\frac{dA}{dt}$ = __________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Let r be the radius of the oil slick and A its area.

Then $A = \pi r^2$ and $\dfrac{dA}{dt} = 2\pi r \dfrac{dr}{dt}$. Substituting $r = 25$ and $\frac{dr}{dt} = 8$, we find $\dfrac{dA}{dt} = 2\pi(25)(8) \approx 1256.63706143592\ \text{m}^2/\text{min}$.

Since $\frac{dr}{dt} = 8$ and $r(0) = 0$, it follows that $r(t) = 8 \cdot t$. Thus, $r(2) = 8 \cdot 2$ and $\dfrac{dA}{dt} = 2\pi(8 \cdot 2)(8) \approx 804.247719318987\text{m}^2/\text{min}$.

---

3. **(2 pts) Problems/setM151_03_11_Related_Rates/3.11.5.pg**
From Rogawski ET section 3.11, exercise 5.

Assume that the radius r of a sphere is expanding at a rate of 13in./min.
The volume of a sphere is $V = \frac{4}{3}\pi r^3$ and its surface area is $SA = 4\pi r^2$.

(a) Determine the rate at which the volume is changing with respect to time when $r = 14$in.

$\frac{dV}{dt}$ = __________

(b) Determine the rate at which the surface area is changing when the radius is $r = 14$in.

$\frac{dSA}{dt}$ = __________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: As the radius is expanding at 14 inches per minute, we know that $\frac{dr}{dt} = 14$ in./min. Taking the derivative with respect to t of the equation $V = \frac{4}{3}\pi r^3$ yields

$$\frac{dV}{dt} = \frac{4}{3}\pi\left(3r^2\frac{dr}{dt}\right) = 4\pi r^2 \frac{dr}{dt}.$$

Substituting $r = 14$ and $\frac{dr}{dt} = 13$ yields

$$\frac{dV}{dt} = 4\pi 14^2(13) = \text{ in./min.}$$

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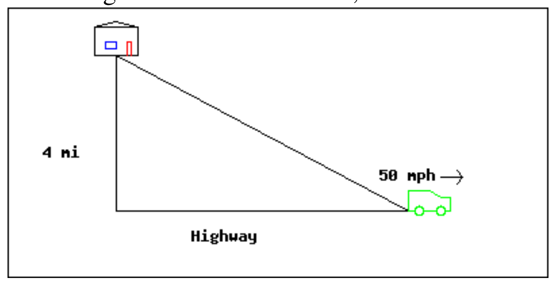
4. **(1 pt) Problems/setM151_03_11_Related_Rates/3.11.9.pg**
From Rogawski ET section 3.11, exercise 9.



A road perpendicular to a highway leads to a farmhouse located 4 mi away. An automobile travels past the farmhouse at a speed of 50mph.

How fast is the distance between the automobile and the farmhouse increasing when the automobile is 7 mi past the intersection of the highway and the road?

Answer: __________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

Let l denote the distance between the automobile and the farmhouse, let d denote the distance between the farmhouse and the intersection of the highway and the road, and let s denote the distance past the intersection of the highway and the road. Then $l^2 = d^2 + s^2$. Taking the derivative of both sides of this equation yields $2l\frac{dl}{dt} = 2s\frac{ds}{dt}$, so:
$\frac{dl}{dt} = \frac{s}{l}\frac{ds}{dt}$.
When the auto is 7 miles past the intersection, we have

$$\frac{dl}{dt} = 50\frac{7}{\sqrt{4^2 + 7^2}} \approx 43.4122 \text{ mph}$$

---

5. **(1 pt) Problems/setM151_03_11_Related_Rates/3.11.15.pg**
From Rogawski ET section 3.11, exercise 15.

At a given moment, a plane passes directly above a radar station at an altitude of 5 miles.

(a) If the plane's speed is 400 mph, how fast is the distance between the plane and the station changing half an hour later?

Answer: __________

(b) How fast is the distance between the plane and the station changing when the plane passes directly above the station?

Answer: __________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Let x be the distance of the plane from the station along the ground and h the distance through the air.

By the Pythagorean Theorem, we have $h^2 = x^2 + 5^2 = x^2 + 25$.

Thus $2h\dfrac{dh}{dt} = 2x\dfrac{dx}{dt}$, and $\dfrac{dh}{dt} = \dfrac{x}{h}\dfrac{dx}{dt}$. After an half hour, $x = \frac{1}{2} \times 400 = 200$ miles. With $x = 200$, $h = \sqrt{200^2 + 25}$, and $\frac{dx}{dt} = 400$, $\dfrac{dh}{dt} = \dfrac{200}{\sqrt{200^2+25}} \times 400 \approx 399.875058563249$ mph.

When the plane is directly above the station, $x = 0$, so the distance between the plane and the station is not changing, for at this instant we have $\dfrac{dh}{dt} = \dfrac{0}{5} \times 400 = 0$ mph.

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6. **(1 pt) Problems/setM151_03_11_Related_Rates/3.11.17.pg**
From Rogawski ET section 3.11, exercise 17.

A hot air balloon rising vertically is tracked by an observer located 4 mi from the lift-off point. At a certain moment, the angle between the observer's line-of-sight and the horizontal is $\frac{\pi}{6}$, and it is changing at a rate of 0.1 rad/min. How fast is the balloon rising at this moment?

Answer: __________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: Let y be the height of the balloon (in miles) and θ the angle between the line-of-sight and the horizontal. Via trigonometry, we have $\tan\theta = \frac{y}{4}$. Therefore, $\sec^2\theta \cdot \dfrac{d\theta}{dt} = \dfrac{1}{4}\dfrac{dy}{dt}$, and $\dfrac{dy}{dt} = 4\dfrac{d\theta}{dt}\sec^2\theta$. Using $\frac{d\theta}{dt} = 0.1$ and $\theta = \frac{\pi}{6}$ yields $\dfrac{dy}{dt} = 4(0.1)\dfrac{1}{\cos^2(\pi/6)} \approx 0.533333333333333$ mi/min.

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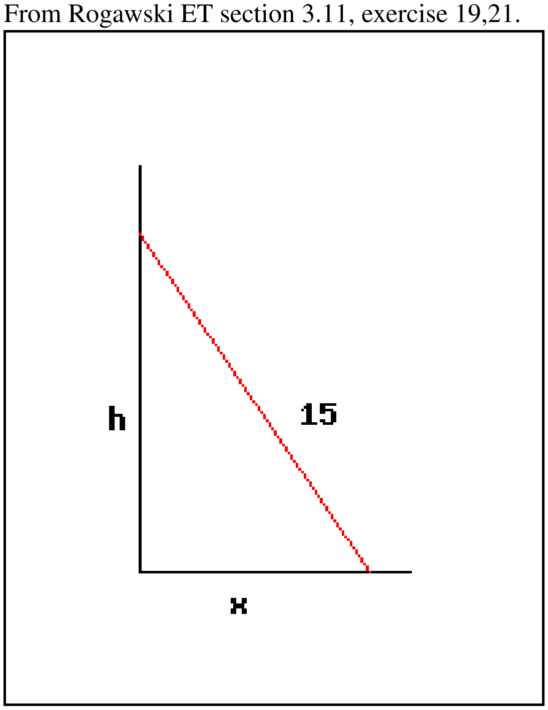
7. **(2 pts) Problems/setM151_03_11_Related_Rates/3.11.21.pg**
From Rogawski ET section 3.11, exercise 19,21.



Consider a ladder that is 15 ft tall sliding down a wall. The variable h is the height of the ladder's top at time t, and x is the distance from the wall to the ladder's bottom.

(a) Assume the bottom slides away from the wall at a rate of 3ft/s. Find the velocity of the top of the ladder at time $t = 3$ if the bottom is 3 ft from the wall at time $t = 0$.

Answer: __________

(b) Suppose that $h(0) = 13$ and the top slides down the wall at a rate of 2ft/s. Calculate x and dx/dt at $t = 3$ s.

$x =$ __________

$\frac{dx}{dt} =$ __________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

Let x denote the distance from the base of the ladder to the wall, and h denote the height of the top of the ladder from the floor. The ladder is 15 ft long, so $h^2 + x^2 = 15^2$. At any time t, $x = 3 + 3t$. Therefore, at time $t = 3$, the base is $3 + 3(3) = 12$ from the wall. To find the rate at which the top of the ladder is moving, we solve for $\frac{dh}{dt}$ in the equation $2h\frac{dh}{dt} + 2x\frac{dx}{dt} = 0$ and thus we obtain
$\frac{dh}{dt} = \frac{-12*3}{\sqrt{15^2-12^2}} \approx -4$ ft/s.

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8. **(1 pt) Problems/setM151_03_11_Related_Rates/3.11.25.pg**
From Rogawski ET section 3.11, exercise 25.

Suppose that both the radius r and height h of a circular cone change at a rate of 9 cm/s. How fast is the volume of the cone changing when $r = 7$ and $h = 19$?

The volume is changing at a rate of __________.

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

Let r be the radius, h be the height, and V be the volume of a right circular cone. Then $V = \frac{1}{3}\pi r^2 h$, whence
$\dfrac{dV}{dt} = \dfrac{1}{3}\pi\left(r^2\dfrac{dh}{dt} + 2hr\dfrac{dr}{dt}\right)$.
When $r = 7$, $h = 19$, and $\frac{dr}{dt} = \frac{dh}{dt} = 9$, we find:
$\frac{dV}{dt} = \frac{\pi}{3}\left(7^2 \cdot 9 + 2 \cdot 19 \cdot 7 \cdot 9\right) \approx 2968.81\ \mathrm{cm}^3/\mathrm{s}$.

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9. **(1 pt) Problems/setM151_03_11_Related_Rates/3.11.27.pg**
From Rogawski ET section 3.11, exercise 27.

A searchlight rotates at a rate of 2 revolutions per minute. The beam hits a wall located 15 miles away and produces a dot of light that moves horizontally along the wall. How fast is this dot moving when the angle θ between the beam and the line through the searchlight perpendicular to the wall is $\frac{\pi}{4}$? Note that $d\theta/dt = 2(2\pi) = 4\pi$.

Speed of dot = __________ mph

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

Let y be the distance between the dot of light and the point of intersection of the wall and the line through the searchlight perpendicular to the wall. Let θ be the angle between the beam of light and the line. Using trigonometry, we have $\tan\theta = \frac{y}{15}$. Therefore, $\sec^2\theta \cdot \frac{d\theta}{dt} = \frac{1}{15}\frac{dy}{dt}$, and $\frac{dy}{dt} = 15\frac{d\theta}{dt}\sec^2\theta$. With $\theta = \frac{\pi}{4}$ and $\frac{d\theta}{dt} = 4\pi$, we find

$$\frac{dy}{dt} = 15\,(4\pi)\,\frac{1}{\cos^2(\pi/4)} = 120\pi \approx 376.991118430775 \text{ mi/min}.$$

Converting to miles per hour gives $\frac{dy}{dt} \approx 22619.4671058465$ mph.

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10. **(1 pt) Problems/setM151_03_11_Related_Rates/3.11.31.pg**

From Rogawski ET section 3.11, exercise 31.

A jogger runs around a circular track of radius 70 ft. Let (x,y) be her coordinates, where the origin is the center of the track. When the jogger's coordinates are (42,56), her x-coordinate is changing at a rate of 17 ft/s. Find dy/dt.

$dy/dt =$ ________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: We have $x^2+y^2 = 70^2$. Thus $2x\frac{dx}{dt}+2y\frac{dy}{dt} = 0$, and $\frac{dy}{dt} = -\frac{x}{y}\frac{dx}{dt}$. With $x = 42$, $y = 56$, and $\frac{dx}{dt} = 17$,

$$\frac{dy}{dt} = -\frac{42}{56}(17) = -12.75 \text{ ft/s}.$$

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11. **(1 pt) Problems/setM151_03_11_Related_Rates/3.11.33.pg**

From Rogawski ET section 3.11, exercise 33.

The pressure P *(in kilopascals)* and volume V *(in cubic centimeters)* of an expanding gas are related by the formula $PV^b = C$, where b and C are constants (this holds in adiabatic expansion, without heat gain or loss).

Find $\frac{dP}{dt}$ if $b = 1.7$, $P = 9$ kPa, $V = 90$ cm^3, and $\frac{dV}{dt} = 80$ cm^3/min.

$\frac{dP}{dt} =$ ________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

Let $PV^b = C$. Then

$$PbV^{b-1}\frac{dV}{dt}+V^b\frac{dP}{dt} = 0,$$

whence

$$\frac{dP}{dt} = -\frac{Pb}{V}\frac{dV}{dt}.$$

Substituting $b = 1.7$, $P = 9$, $V = 90$, and $\frac{dV}{dt} = 80$,

$$\frac{dP}{dt} = -\frac{(9)(1.7)}{90}(80) \approx -13.6 \text{ kPa/min}.$$

1. **(2 pts) Problems/setM151_04_01_Lin_Approx_Apps/4.1.PQ1.pg**
From Rogawski ET section 4.1, exercise PQ1.
(a) Estimate $g(9.1)-g(9)$ if $g'(9)=2$.

$g(9.1)-g(9)\approx$ ______
(b) Estimate $f(4.6)$ if $f(4)=6$ and $f'(4)=4$.

$f(4.6)\approx$ ______

2. **(1 pt) Problems/setM151_04_01_Lin_Approx_Apps/4.1.PQ3.pg**
From Rogawski ET section 4.1, exercise PQ2.
The velocity of a train at a given instant is 140 ft/s. How far does the train travel during the next half-second (use the Linear Approximation)?

Answer: ______

3. **(1 pt) Problems/setM151_04_01_Lin_Approx_Apps/4.1.1.pg**
From Rogawski ET section 4.1, exercise 1.
Consider $f(x)=x$.
Use the Linear Approximation to estimate $\Delta f=f(1.02)-f(1)$.

$\Delta f\approx$ ______

4. **(1 pt) Problems/setM151_04_01_Lin_Approx_Apps/4.1.5.pg**
From Rogawski ET section 4.1, exercise 5.
Consider $f(x)=e^{3x}$.
Use the Linear Approximation to estimate $\Delta f=f(3.04)-f(3)$.

$\Delta f\approx$ ______

5. **(1 pt) Problems/setM151_04_01_Lin_Approx_Apps/4.1.7.pg**
From Rogawski ET section 4.1, exercise 7.
Consider $f(x)=9\ln(x)$.
Use the Linear Approximation to estimate $\Delta f=f((e^6)+0.4)-f(e^6)$.

$\Delta f\approx$ ______

6. **(1 pt) Problems/setM151_04_01_Lin_Approx_Apps/4.1.9.pg**
From Rogawski ET section 4.1, exercise 9.
Estimate Δf using the Linear Approximation and use a calculator to compute both the error and the percentage error.
$f(x)=\sqrt{3+x}, \qquad a=3, \qquad \Delta x=1$
$\Delta f\approx$ ______

The error in the Linear Approximation is ______

The percentage error is ______
SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:
Let $f(x)=\sqrt{3+x}$, $a=3$, $\Delta x=1$. Then $f'(x)=\frac{1}{2}(3+x)^{-1/2}$
$f'(a)=f'(3)=\frac{1}{2}(3+3)^{-1/2}=$ and
$\Delta f\approx f'(a)\Delta x=(1)=0.204124145231932$
The actual change is: $\Delta f=f(a+\Delta x)-f(a)=f(4)-f(3)\approx$
The error in the Linear Approximation is therefore: $|-0.204124145231932|=$
In percentage terms, the error is: $|\;|\times 100\%=\%$.

7. **(1 pt) Problems/setM151_04_01_Lin_Approx_Apps/4.1.11.pg**
From Rogawski ET section 4.1, exercise 11.
Estimate Δf using the Linear Approximation and use a calculator to compute both the error and the percentage error.
$f(x)=\sin x, \qquad a=0, \qquad \Delta x=0.08$
$\Delta f\approx$ ______

The error in the Linear Approximation is ______

The percentage error is ______
SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: The linear approximation to Δf at $x=0$ is $f'(0)\Delta x=\cos(0)\Delta x=\Delta x=0.08$.
The error is $|\sin(0.08)-0.08|=|0.0799146939691727-0.08|=8.53060308273063e-05$. The percentage error is $|\frac{\sin(0.08)-L(0.08}{\sin(0.08)}|\times 100\%=0.106746364892811\%$.

8. **(1 pt) Problems/setM151_04_01_Lin_Approx_Apps/4.1.13.pg**
From Rogawski ET section 4.1, exercise 13.
Estimate Δf using the Linear Approximation and use a calculator to compute both the error and the percentage error.
$f(x)=\cos x, \qquad a=\frac{\pi}{4}, \qquad \Delta x=0.03$
$\Delta f\approx$ ______

The error in the Linear Approximation is ______
The percentage error is ______
SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:
Let $f(x)=\cos(x)$, $a=\frac{\pi}{4}$, $\Delta x=0.03$. Then $f'(x)=-\sin(x)$,
$f'(a)=f'(\frac{\pi}{4})=-\sin(\frac{\pi}{4})=-0.707107$
$\Delta f\approx f'(a)\Delta x=-0.707107\cdot 0.03=-0.0212132$
The actual change is: $\Delta f=f(a+\Delta x)-f(a)=f(\frac{\pi}{4}+0.03)-f(\frac{\pi}{4})=-0.0215282$
The error in the Linear Approximation is therefore:

$|-0.0215282+0.0212132| = 0.000314992$

In percentage terms, the error is: $|\frac{0.000314992}{-0.0215282}| \times 100\% = 1.46316\%$

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9. **(1 pt) Problems/setM151_04_01_Lin_Approx_Apps/4.1.15.pg**

From Rogawski ET section 4.1, exercise 15.

Estimate Δf using the Linear Approximation and use a calculator to compute both the error and the percentage error.

$f(x) = x^{1/3}e^{x-1}, \qquad a = 1, \qquad \Delta x = 0.3$

$\Delta f \approx$ ________

The error in the Linear Approximation is ________

The percentage error is ________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: The linear approximation to Δf at $x = 1$ is $f'(1)\Delta x$. The derivative is$f'(x) = \frac{1}{3}x^{-2/3}e^{x-1} + x^{1/3}e^{x-1}$, so $f'(1) = \frac{1}{3}1^{-2/3}e^{1-1} + 1^{1/3}e^{1-1} = 1/3+1 = 4/3$. Thus, the linear approximation to $\Delta f = \frac{4}{3}\Delta x = 0.4$.

The error is $|\ \Delta f - 0.4\ | = |\ f(1+0.3) - f(1) - 0.4\ | = 0.0732263$.

The percentage error is $|\ \frac{error}{actualvalue}\ | \times 100\% = |\ \frac{error}{f(1+\Delta x)}\ | \times 100\% = |\ \frac{0.0732263}{1.47323}\ | \times 100\% = 15.4738\%$.

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10. **(1 pt) Problems/setM151_04_01_Lin_Approx_Apps/4.1.19.pg**

From Rogawski ET section 4.1, exercise 19.

Estimate the quantity using Linear Approximation and find the error using a calculator.

$\frac{1}{\sqrt{119}} - \frac{1}{11}$

The Linear Approximation is: $\Delta f \approx$ ________

The error in Linear Approximation is ________

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11. **(1 pt) Problems/setM151_04_01_Lin_Approx_Apps/4.1.31.pg**

From Rogawski ET section 4.1, exercise 31.

The side s of a square carpet is measured at 9 ft. Estimate the maximum error in the area A of the carpet if s is accurate to within 7/8 in.

$\Delta A \approx$ ________ ft^2

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12. **(1 pt) Problems/setM151_04_01_Lin_Approx_Apps/4.1.35.pg**

From Rogawski ET section 4.1, exercise 35.

The *stopping distance* for an automobile (after applying the brakes) is approximately $F(s) = 1.2s + 0.059s^2$ ft, where s is the speed in mph. Use the Linear Approximation to estimate the stopping distance per additional mph when $s = 25$ and when $s = 70$

When $s = 25$ mph, $\Delta F \approx$ ________

When $s = 70$ mph, $\Delta F \approx$ ________

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13. **(1 pt) Problems/setM151_04_01_Lin_Approx_Apps/4.1.41.pg**

From Rogawski ET section 4.1, exercise 41.

Find the linearization $L(x)$ of $y = 10\sin(2x)\cos(x)$ at $a = 0$.

$L(x) =$ ________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: The linearization $L(x)$ of y at $a = 0$ is given by the formula $L(x) = y(0) + y'(0)(x-0) = 0 + 20x = 20x$.

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14. **(1 pt) Problems/setM151_04_01_Lin_Approx_Apps/4.1.43.pg**

From Rogawski ET section 4.1, exercise 43.

Find the linearization of $y = (2+x)^{-1/2}$ at $a = 0$.

$L(x) =$ ________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

Let $f(x) = (2+x)^{-1/2}$. Then $f'(x) = -\frac{1}{2}(2+x)^{-3/2}$

$f'(a) = f'(0) = -\frac{1}{2}(0+2)^{-3/2} = -0.176777$

The linearization at $a = 0$ is: $L(x) = f'(a)(x-a) + f(a) =$

$= -0.176777(x-0) + 0.707107 =$

$= -0.176777x - 0.707107$

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15. **(1 pt) Problems/setM151_04_01_Lin_Approx_Apps/4.1.45.pg**

From Rogawski ET section 4.1, exercise 45.

Find the linearization $L(x)$ of $y = (5+4x^2)^{-1/2}$ at $a = 0$.

$L(x) =$ ________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: The linearization $L(x)$ of yat $a = 0$ is given by the formula $L(x) = y(0) + y'(0)(x-0) = 5^{-1/2} + (0)(x) = 5^{-1/2}$.

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16. **(1 pt) Problems/setM151_04_01_Lin_Approx_Apps/4.1.47.pg**

From Rogawski ET section 4.1, exercise 47.

Find the linearization of $y = \sin^{-1} x$ at $a = \frac{1}{2}$.

$L(x) =$ ________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution:

Let $f(x) = \sin^{-1} x = \arcsin x \qquad$ Then $f'(x) = \frac{1}{\sqrt{1-x^2}}$

$f'(a) = f'(\frac{1}{2}) = \frac{1}{\sqrt{1-\frac{1}{2}^2}} = 1.1547$

The linearization at $a = 0.5$ is: $L(x) = f'(a)(x-a) + f(a) = 1.1547(x-0.5) + 0.523599 =$

$= 1.1547x + (-0.0537515)$

17. **(1 pt) Problems/setM151_04_01_Lin_Approx_Apps/4.1.49.pg**
From Rogawski ET section 4.1, exercise 49.

Find the linearization $L(x)$ of $y = e^{9x}\ln(x)$ at $a = 1$.

$L(x)$ = ________

SOLUTION: (Instructor solution preview: show the student solution after due date.)

Solution: The linearization $L(x)$ of y at $a = 1$ is given by the formula $L(x) = y(1) + y'(1)(x-1) = 0 + (e^{9x})(x-1) = e^9x - e^9$.

18. **(1 pt) Problems/setM151_04_01_Lin_Approx_Apps/4.1.53.pg**
From Rogawski ET section 4.1, exercise 53.
Approximate using linearization and use a calculator to compute the percentage error.

$\sqrt{65}$
$\sqrt{65} \approx$ ________

The percentage error is ________

19. **(1 pt) Problems/setM151_04_01_Lin_Approx_Apps/4.1.57.pg**
From Rogawski ET section 4.1, exercise 57.
Approximate using linearization and use a calculator to compute the percentage error.

$(125.995)^{1/3}$
$(125.995)^{1/3} \approx$ ________

The percentage error is ________