Honors PreCalculus

Extra Practice

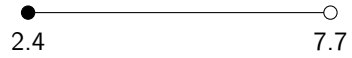
Contents

Chapter 1

Basic Set Theory and Interval Notation

You are given either interval notation, set-builder notation, or a graph. Write each of the following in its other 2 forms.

1. $(-5, 8]$
2. $\{x|x \leq 1\}$
3. 

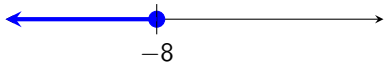
4. $\{x|x \neq 4, 11\}$
5. 

6. $(9, \infty)$

Write each using interval notation and graph on a number line.

7. $\{x|x \geq 2\}$
8. $\{x|x < -8\}$
9. $\{x|x \neq 3\}$
10. $\{x|x \neq -2, 5\}$

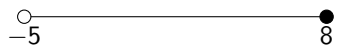
You are given the graph of an interval. Write the interval and set-builder notation for it.

11. 

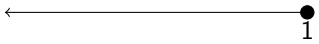
12. 

Basic Set Theory and Interval Notation Key

1. $\{x| -5 < x \leq 8\}$



2. $(-\infty, 1]$

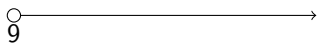


3. $[-3, \infty)$ $\{x|x \geq -3\}$

4. $(-\infty, 4) \cup (4, 11) \cup (11, \infty)$

5. $[2.4, 7.7)$ $\{x|2.4 \leq x < 7.7\}$

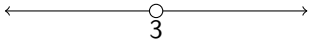
6. $\{x|x > 9\}$



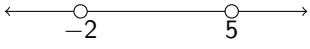
7. $[2, \infty)$

8. $(-\infty, -8)$

9. $(-\infty, 3) \cup (3, \infty)$



10. $(\infty, -2) \cup (-2, 5) \cup (5, \infty)$



11. $(-\infty, -8]$ $\{x|x \leq -8\}$

12. $(-\infty, 7) \cup (7, 12) \cup (12, \infty)$ $\{x|x \neq 7, 12\}$

Chapter 2

Functions and Their Graphs

2.1 Evaluating Functions

Given $f(x) = -3x^2 + 4x$ and $g(x) = \frac{1}{x} - 5$, evaluate each.

1. $f(5)$
2. $f(-2)$
3. $f(0)$
4. $g(1)$
5. $g(-5)$
6. $g(1/4)$

2.2 Domain of Functions

Find the domain of each write your answers in interval notation.

1. $f(x) = -8x^2 - 7x + 1$
2. $g(x) = \sqrt{5x + 12} - 2$
3. $h(x) = \frac{x+2}{9x-7}$
4. $f(x) = -5x + 4$
5. $f(x) = x^2 + 2$
6. $f(x) = \frac{2x+1}{3x-5}$
7. $f(x) = \sqrt{3x - 12}$
8. $f(x) = \frac{x}{x^2-16}$
9. $f(x) = \frac{x+4}{x^3-4x}$
10. $f(x) = \frac{x}{\sqrt{x-4}}$
11. $f(x) = \frac{x^2+1}{2x^2+8}$
12. $f(x) = -\frac{x+7}{x^2-5x-6}$
13. $g(x) = \sqrt{2x + 3}$
14. $h(x) = \sqrt[3]{2x + 3}$
15. $f(x) = -\frac{7x-10}{x^2+3x+2}$
16. $g(x) = \sqrt{-9x + 8}$
17. $h(x) = -\sqrt[3]{4x + 1}$
18. $f(x) = \sqrt[3]{8x + 1}$
19. $g(x) = \frac{x^2-1}{\sqrt{x+3}}$
20. $h(x) = \frac{3}{9+\frac{4}{x+7}}$
21. $f(x) = \frac{x+1}{\sqrt{10x+8}}$
22. $g(x) = \frac{5}{1+\frac{3}{x+2}}$
23. $i(x) = \frac{7}{3-\frac{4}{x+1}}$
24. $n(x) = \frac{7x+14}{\sqrt{2x-1}}$
25. $a(x) = \frac{\frac{x}{x-2}}{\frac{3}{x-2} + 6}$
26. $d(x) = \frac{7x-5}{\sqrt[3]{5x+2}}$

2.3 Piecewise Functions

Find the value of each given the piecewise function below. Use exact answers when possible.

$$f(x) = \begin{cases} x^2 - 1 & \text{if } x < -3 \\ 0.2x + 7 & \text{if } -3 \leq x < 2 \\ \sqrt{5x} & \text{if } x \geq 2 \end{cases}$$

1. $f(3)$
2. $f(0)$
3. $f(-2)$
4. $f(-3)$
5. $f(0.5)$

Find each of the following given the piecewise function

$$f(x) = \begin{cases} x^2 - 7 & x \leq -4 \\ \sqrt{2x + 7} & -4 < x < 0 \\ |-x - 1| & x \geq 0 \end{cases}$$

6. $f(3)$
7. $f(-2)$
8. $f(0)$
9. $f(-5)$

Find the value of each given the piecewise function below. Round to 3 decimal places when necessary.

$$f(x) = \begin{cases} x^2 - 5 & \text{if } x \leq -3 \\ \sqrt{-4x + 1} & \text{if } -3 < x \leq 0 \\ \frac{5x^2}{x+7} & \text{if } x > 0 \end{cases}$$

10. $f(7)$
11. $f(-3)$
12. $f(1)$
13. $f(0)$
14. $f(-1)$
15. $f(-3/2)$

Evaluating Functions

1. -55
2. -20
3. 0
4. -4
5. -5.2
6. -1

Domain of Functions

1. $(-\infty, \infty)$
2. $\left[\frac{-12}{5}, \infty\right)$
3. $\left(-\infty, \frac{7}{9}\right) \cup \left(\frac{7}{9}, \infty\right)$
4. $(-\infty, \infty)$
5. $(-\infty, \infty)$
6. $\left(-\infty, \frac{5}{3}\right) \cup \left(\frac{5}{3}, \infty\right)$
7. $[4, \infty)$
8. $(-\infty, -4) \cup (-4, 4) \cup (4, \infty)$
9. $(-\infty, -2) \cup (-2, 0) \cup (0, 2) \cup (2, \infty)$
10. $(4, \infty)$
11. $(-\infty, \infty)$
12. $(-\infty, -1) \cup (-1, 6) \cup (6, \infty)$
13. $\left[-\frac{3}{2}, \infty\right)$
14. $(-\infty, \infty)$
15. $(-\infty, -2) \cup (-2, -1) \cup (-1, \infty)$
16. $\left(-\infty, \frac{8}{9}\right]$
17. $(-\infty, \infty)$
18. $(-\infty, \infty)$
19. $(-3, \infty)$
20. $\left(-\infty, -\frac{67}{9}\right) \cup \left(-\frac{67}{9}, -7\right) \cup (-7, \infty)$
21. $\left(-\frac{4}{5}, \infty\right)$
22. $(\infty, -5) \cup (-5, -2) \cup (-2, \infty)$
23. $(-\infty, -1) \cup (-1, \frac{1}{3}) \cup (\frac{1}{3}, \infty)$
24. $(\frac{1}{2}, \infty)$
25. $\left(-\infty, \frac{3}{2}\right) \cup \left(\frac{3}{2}, 2\right) \cup (2, \infty)$
26. $\left(-\infty, -\frac{2}{5}\right) \cup \left(-\frac{2}{5}, \infty\right)$

Piecewise Functions

1. $\sqrt{15} \approx 3.873$
2. 7
3. 6.6
4. 6.4
5. 7.1
6. 4
7. $\sqrt{3} \approx 1.732$
8. 1
9. 18
10. 17.5
11. 4
12. $\frac{5}{8}$
13. 1
14. $\sqrt{5} \approx 2.236$
15. $\sqrt{7} \approx 2.646$

Chapter 3

Properties of Functions

3.1 Maxima and Minima

Find the coordinates of the any relative maxima or minima. Round to 3 decimal places when necessary.

1. $f(x) = x^2 - 3x^2 + 5$
2. $g(x) = -0.4x^3 + 0.6x^2 + 3x - 2$
3. $f(x) = -x^4 + 3x^2 - 2x + 6$
4. $g(x) = 0.25x^5 - 0.1x^4 + 2x^2 - 6x$
5. $f(x) = -4x^3 + 2x^2 + 10x + 4$
6. $g(x) = x^4 - 4x^3 + 3x^2 + 4x - 4$
7. The concentration C of a medication in the bloodstream t hours after being administered can be modeled by

$$C(t) = -0.002t^4 + 0.039t^3 - 0.285t^2 + 0.766t + 0.085, \quad t \geq 0$$

   After how many hours will the concentration be the highest?

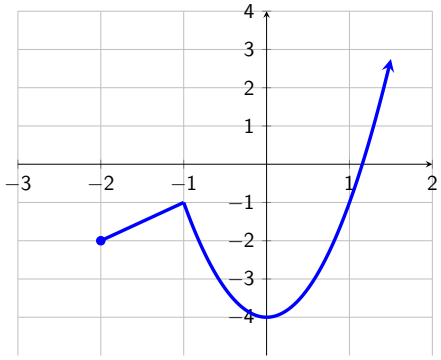
3.2 Increasing, Decreasing, and Constant Intervals

Find the intervals in which each is increasing or decreasing. Round to 3 decimal places when necessary.

1. $f(x) = x^2 - 3x^2 + 5$
2. $g(x) = -0.4x^3 + 0.6x^2 + 3x - 2$
3. $f(x) = x^3 + 2x^2 - 4x - 8$
4. $g(x) = x^4 - 2x^2 + 1$
5. $h(x) = \sqrt{x+1} - 2$
6. $f(x) = -4x^3 + 2x^2 + 10x + 4$
7. $g(x) = x^4 - 4x^3 + 3x^2 + 4x - 4$

3.3 Miscellaneous

Use the graph of $y = f(x)$ below to answer the following questions. Write your answers using interval notation.

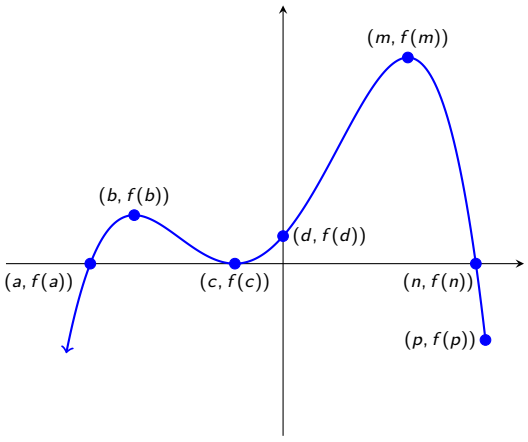


1. Domain of f
2. Range of f
3. Relative Minimum
4. Relative Maximum
5. $f(1)$
6. $f(0)$
7. Increasing Interval(s)
8. Decreasing Interval(s)
9. Absolute Maximum
10. Absolute Minimum

Find each of the following given $f(x) = -2x^3 + 6x^2 - 5x + 1$. Round to 3 decimal places and use interval notation when applicable.

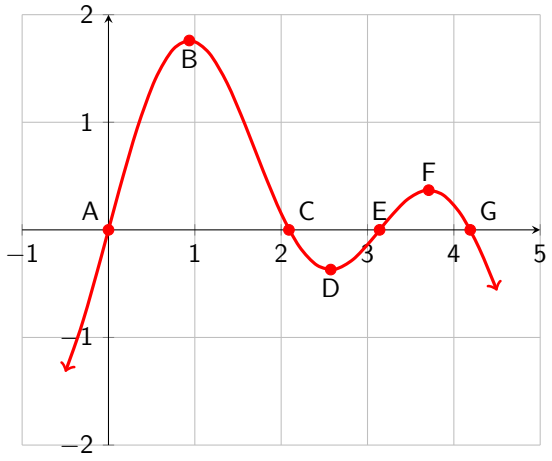
11. $f(7)$
12. $f(-2)$
13. Rel. Max
14. Rel. Min
15. Global Max
16. Global Min
17. Increasing Interval(s)
18. Decreasing Interval(s)

Use the graph of $f(x)$ to answer each.



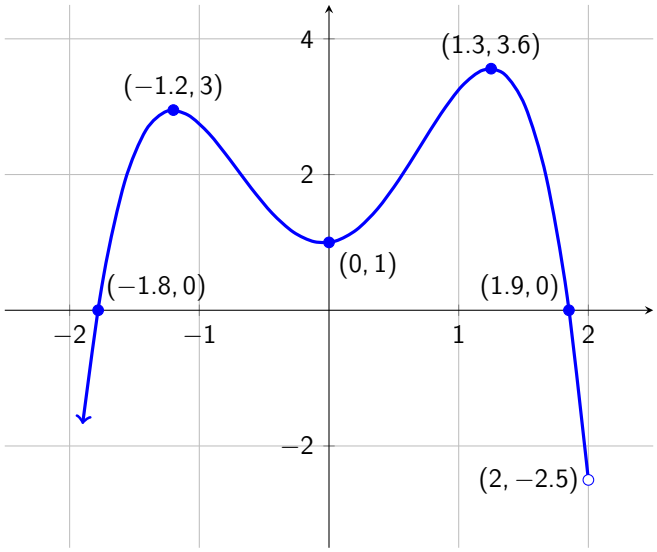
19. Relative maxima of $f(x)$
20. Relative minima of $f(x)$
21. Absolute maxima of $f(x)$
22. Absolute minima of $f(x)$
23. Intervals where f is increasing
24. Intervals where f is decreasing
25. Zeros of f

Given the labeled points A through G on the graph of $f(x)$ below, find each of the following.



26. Increasing interval(s)
27. Decreasing interval(s)
28. Relative max
29. Relative min
30. Global max
31. Global min
32. Zeros of f
33. Number of solutions to $f(x) = 1$

Answer each of the following about the function $f(x)$ below.



34. Domain of f
35. Range of f
36. Relative maxima
37. Relative minima
38. Absolute maximum
39. Absolute minimum
40. Increasing intervals
41. Decreasing intervals
42. Zeros of $f(x)$
43. Number of solutions to $f(x) = 2$

Maxima and Minima

1. Rel max @ $(0, 5)$; No rel min
2. Rel max @ $(2.158, 3.248)$; Rel min @ $(-1.158, -4.048)$
3. Rel Max $(-1.366, 10.848)$ and $(1, 6)$; Rel Min $(0.366, 5.652)$
4. Rel Max $(-1.716, 11.598)$; Rel Min $(1.132, -3.929)$
5. Rel Max: $(1.095, 12.096)$; Rel Min $(-0.761, -0.680)$
6. Rel Max: $(1.366, 0.348)$; Rel Min: $(-0.366, -4.848)$ and $(2, 0)$
7. About 2.16 hours

Increasing, Decreasing, and Constant Intervals

1. Increasing: $(-\infty, 0)$ Decreasing: $(0, \infty)$
2. Increasing: $(-1.158, 2.158)$ Decreasing: $(-\infty, -1.158) \cup (2.158, \infty)$
3. Inc: $(-\infty, -2) \cup \left(\frac{2}{3}, \infty\right)$ Dec: $\left(-2, \frac{2}{3}\right)$
4. Inc; $(-1, 0) \cup (1, \infty)$ Dec: $(-\infty, -1) \cup (0, 1)$
5. Inc: $(-1, \infty)$ No intervals where it is decreasing
6. Inc: $(-0.761, 1.095)$; Dec: $(-\infty, -0.761) \cup (1.095, \infty)$
7. Inc: $(-0.366, 1.366) \cup (2, \infty)$; Dec: $(-\infty, -0.366) \cup (1.366, 2)$;

Miscellaneous

1. $[-2, \infty)$
2. $[-4, \infty)$
3. $(0, -4)$
4. $(-1, -1)$
5. -1
6. $-4)$
7. $(-2, -1) \cup (0, \infty)$
8. $(-1, 0)$
9. $(0, -4)$
10. None
11. -426
12. 51
13. (1.408, 0.272)
14. (0.592, -0.272)
15. None
16. None
17. (0.592, 1.408)
18. $(-\infty,$ 0.592) $\cup$ (1.408, ∞)
19. $(b, f(b))$ and $(m, f(m))$
20. $(c, f(c))$
21. $(m, f(m))$
22. None
23. $(-\infty, b) \cup (c, m)$
24. $(b, c) \cup (m, p)$
25. $x = a$, $x = c$, $x = n$
26. $(\infty, B) \cup (D, F)$
27. $(B, D) \cup (F, \infty)$
28. B and F
29. D
30. B
31. None
32. A, C, E, G
33. 2
34. $(-\infty, 2)$
35. $(-\infty, -2.5) \cup (-2.5, 3.6]$
36. $(-1.2, 3)$ and $(1.3, 3.6)$
37. $(0, 1)$
38. $(1.3, 3.6)$
39. Does not exist
40. $(-\infty, -1.2) \cup (0, 1.3)$
41. $(-1.2, 0) \cup (1.3, 2)$
42. $(-1.8, 0)$ and $(1.9, 0)$
43. 4

Chapter 4

Linear Functions and Slope

4.1 Equations of Lines

Write the equation of each line **in point-slope form** that goes through each pair of points.

1. $(-2, 1)$, $(7, 8)$
2. $(0, 4)$, $(9, -15)$
3. $(-1, -2)$, $(-3, -13)$

4.2 Average Rate of Change

For the function $f(x) = x^2$, compute the average rate of change for each interval.

1. $[1, 1.1]$
2. $[1, 1.01]$
3. $[1, 1.001]$
4. $[1, 1.0001]$
5. For your answers in the previous four problems, what value do your average rates of change get closer and closer to?

Find the average rate of change of the function $f(x) = -6x^2 + 7x + 4$ over each specified interval.

6. $[-2, -1]$
7. $[5, 6]$
8. $[0, 1]$
9. $[5, 5.001]$
10. $[5, 5.0001]$
11. $[5, 5.00001]$
12. What value are your last 3 answers getting closer to?

For the function $f(x) = -3x^2 + 5$, determine the average rate of change of each over the given interval.

13. $[7, 7.001]$
14. $[7, 7.0001]$
15. $[7, 7.00001]$
16. For your answers in the previous three problems, what value do your average rates of change get closer and closer to?

Given $f(x) = \sqrt{x}$, find the average rate of change of each over the given interval.

17. $[1, 1.0001]$
18. $[1, 1.00001]$
19. $[1, 1.000001]$
20. For your answers in the previous three problems, what value do your average rates of change get closer and closer to?

Given $f(x) = 6\sqrt{x}$, find the average rate of change of each over the given interval.

21. $[25,\ 25.1]$
22. $[25,\ 25.01]$
23. $[25,\ 25.001]$
24. For your answers in the previous three problems, what value do your average rates of change get closer and closer to?

Find the average rate of change of the function $f(x) = -7x^3 + 6\sqrt{3x} + 4$ over each interval. Round your answers to 4 decimal places.

25. $[0, 1]$
26. $[10, 11]$
27. $[8, 15]$

Equations of Lines

1. $y - 1 = \frac{7}{9}(x + 2)$ or $y - 8 = \frac{7}{9}(x - 7)$
2. $y - 4 = -\frac{19}{9}(x - 0)$ or $y + 15 = -\frac{19}{9}(x - 9)$
3. $y + 2 = \frac{11}{2}(x + 1)$ or $y + 13 = \frac{11}{2}(x + 3)$

Average Rate of Change

1. 2.1
2. 2.01
3. 2.001
4. 2.0001
5. 2
6. 25
7. -59
8. 1
9. -53.006
10. -53.0006
11. -53.00006
12. -53
13. -42.003
14. -42.0003
15. -42.00003
16. -42
17. -0.499988
18. -0.4999988
19. -0.49999988
20. -0.5
21. 0.5994
22. 0.59999
23. 0.6
24. 0.6
25. 3.3923
26. $-2,315.3960$
27. -2861.4492

Chapter 5

Function Transformations

Write the function for $g(x)$ if it is the result of $f(x)$ after the following ordered sequence of transformations.

1. (1) Vertical stretch by 3
   (2) Shift left 1 unit
   (3) Reflect across y-axis
2. (1) Horizontal compression by 2
   (2) Shift up 1 unit
3. (1) Reflect across x-axis
   (2) Vertical compression by 4
   (3) Move right 7 units

Write the function $g(x)$ that is a result of the following ordered sequence of transformations to $f(x) = |x|$.

4. (1) Reflect across x-axis
   (2) Shift right 3 units
   (3) Horizontal stretch by factor of 5
5. (1) Shift down 2 units
   (2) Reflect across y-axis
   (3) Shift up 1 unit
6. (1) Horizontal compression by factor of 7
   (2) Vertical compression by factor of 4
   (3) Shift left 9 units

Given $f(x) = \sqrt{x}$, determine the resulting function $g(x)$ after the following ordered sequence of transformations.

7. (1) Shift up 2 units
   (2) Horizontal stretch by 5
   (3) Shift left 3 units
8. (1) Vertical compression by factor of 3
   (2) Reflect across y-axis
   (3) Horizontal compression by 5
9. (1) Shift right 8 units
   (2) Reflect across x-axis
   (3) Horizontal compression by factor of 4

Write the final equation of $g(x)$ if it is found by taking $f(x) = \sqrt{x}$ after the following ordered sequence of transformations.

10. (1) Shift right 2 units
    (2) Horizontal stretch by factor 3
    (3) Shift down 2 units
    (4) Reflect across x-axis

11. (1) Horizontal stretch by factor 3
    (2) Shift left 1 unit
    (3) Shift up 2 units
    (4) Reflect across y-axis

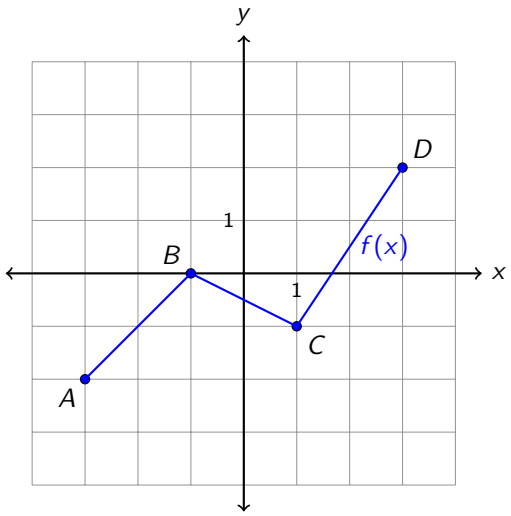
12. (1) Vertical stretch by factor 5
    (2) Horizontal stretch by factor 2
    (3) Shift up 3 units
    (4) Reflect across x-axis

Find the equation for $g(x)$ if $g(x)$ is found by performing the following *ordered* sequence of transformations to $f(x) = \frac{1}{x}$.

13. (1) Shift left 3 spaces
    (2) Reflect across y-axis
    (3) Shift down 5 spaces
    (4) Vertical stretch by factor of 7

14. (1) Shift up 3 spaces
    (2) Reflect across x-axis
    (3) Shift right 5 spaces
    (4) Horizontal compression by factor of 7

Given the graph of $f(x)$ below, find the new coordinates of each point after the following transformations.



15. $-2f(x+1)$

16. $f\left(-\frac{1}{2}x\right) - 3$

17. $\frac{1}{2}f(-x-2)+2$

18. $f(2x+2)-1$

19. $-3f(-x+1)+2$

20. $5f\left(-\frac{1}{2}x\right)$

Function Transformations Key

1. $g(x) = 3f(-x+1)$
2. $g(x) = f(2x)+1$
3. $g(x) = -\frac{1}{4}f(x-7)$
4. $g(x) = -\left|\frac{1}{5}x-3\right|$
5. $g(x) = |-x|-1$
6. $g(x) = \frac{1}{4}|7(x+9)| = \frac{1}{4}|7x+63|$
7. $g(x) = \sqrt{\frac{1}{5}(x+3)}+2 = \sqrt{\frac{1}{5}x+\frac{3}{5}}+2$
8. $g(x) = \frac{1}{3}\sqrt{-5x}$
9. $g(x) = -\sqrt{4x-8}$
10. $g(x) = -\left(\sqrt{\frac{1}{3}x-2}-2\right) = -\sqrt{\frac{1}{3}x-2}+2$
11. $g(x) = \sqrt{\frac{1}{3}(-x+1)}+2 = \sqrt{-\frac{1}{3}x+\frac{1}{3}}+2$
12. $g(x) = -\left(5\sqrt{\frac{1}{2}x}+3\right) = -5\sqrt{\frac{1}{2}x}-3$
13. $g(x) = \frac{7}{-x+3}-35$
14. $g(x) = -\frac{1}{7x-5}-3$
15. $A'(-4,4),\ B'(-2,0),\ C'(0,2),\ D'(2,-4)$
16. $A'(6,-5),\ B'(2,-3),\ C'(-2,-4),\ D'(-6,-1)$
17. $A'(1,1),\ B'(-1,2),\ C'(-3,1.5),\ D'(-5,3)$
18. $A'(-2.5,-3),\ B'(-1.5,-1),\ C'(-0.5,-2),\ D'(0.5,1)$
19. $A'(4,8),\ B'(2,2),\ C'(0,5),\ D'(-2,-4)$
20. $A'(6,-10),\ B'(2,0),\ C'(-2,-5),\ D'(-6,10)$

Chapter 6

Function Operations

6.1 Adding, Subtracting, Multiplying, and Dividing Functions

Given $f(x) = x + 5$, $g(x) = x^2 - 1$, and $h(x) = \sqrt{x - 10}$, simplify or evaluate each.

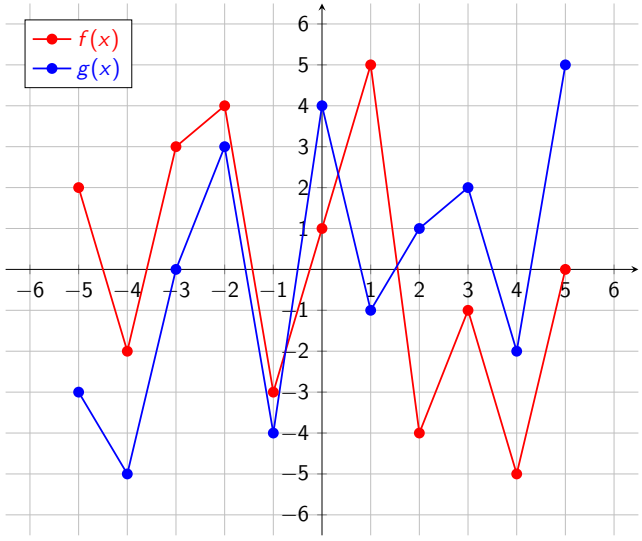
1. $(g - f)(x)$
2. $(fh)(14)$
3. $(f + g)(x)$

Find each of the following given the table below.

x	**−4**	**−3**	**−2**	**−1**	**0**	**1**	**2**	**3**	**4**
f(x)	−3	0	−1	3	1	2	4	−4	−2
g(x)	3	−1	0	1	4	−2	−4	2	−3

4. $(f + g)(-2)$
5. $(f - g)(0)$
6. $(fg)(1)$
7. $\left(\frac{f}{g}\right)(3)$
8. $(f + f)(-4)$

Find each of the following given the graphs of $f(x)$ (in red) and $g(x)$ (in blue) below:



9. $(f + g)(2)$
10. $(f - g)(1)$
11. $(g - f)(-3)$
12. $(fg)(4)$
13. $\left(\frac{f}{g}\right)(0)$

6.2 Operations with Functions: Domain

Given $f(x) = \sqrt{2x+7}$ and $g(x) = 3x+3$, find the domain of each.

1. $(f+g)(x)$
2. $\left(\frac{f}{g}\right)(x)$
3. $\left(\frac{g}{f}\right)(x)$

6.3 Difference Quotient

Write the difference quotient for each.

1. $f(x) = 2x - 7$
2. $g(x) = x^2 + 4x$
3. $h(x) = -1$
4. $f(x) = \frac{3}{x+2}$
5. $g(x) = \sqrt{3x}$
6. $f(x) = x^2 - 2x + 5$
7. $g(x) = \frac{5}{x}$
8. $f(x) = -2x^2 + 3x - 5$
9. $g(x) = \frac{6}{2x+3}$
10. $h(x) = \sqrt{7x+5}$
11. $f(x) = -x^2 + x$
12. $f(x) = 3x - 1$
13. $f(x) = x^3 + 5x$

Adding, Subtracting, Multiplying, and Dividing Functions

1. $x^2 - x - 6$
2. 38
3. $x^2 + x + 4$
4. -1
5. -3
6. -4
7. -2
8. -6
9. -3
10. 6
11. -3
12. 10
13. $\frac{1}{4}$

Operations with Functions: Domain

1. $\left[-\frac{7}{2}, \infty\right)$
2. $\left[-\frac{7}{2}, -1\right) \cup (-1, \infty)$
3. $\left(-\frac{7}{2}, \infty\right)$

Difference Quotient

1. 2
2. $2x + h + 4$
3. 0
4. $\frac{-3}{(x+2)(x+h+2)}$
5. $\frac{3}{\sqrt{3x+3h}+\sqrt{3x}}$
6. $2x + h - 2$
7. $\frac{-5}{x(x+h)}$
8. $-4x - 2h + 3$
9. $\frac{-12}{(2x+3)(2x+2h+3)}$
10. $\frac{7}{\sqrt{7x+7h+5}+\sqrt{7x+5}}$
11. $-2x - h + 1$
12. 3
13. $3x^2 + 3xh + h^2 + 5$

Chapter 7

Polynomials and Their Graphs

Determine the end behavior of each.

1. $f(x) = -x^5 + \sqrt{7}x^3 - 2x^2$
2. $g(x) = 4x^2 - 16x^6 + 3x$
3. $h(x) = 1 + x^{11} - 4x^8$
4. $f(x) = -x^4 + 3x^2 - 2x + 6$
5. $g(x) = 0.25x^5 - 0.1x^4 + 2x^2 - 6x$
6. $f(x) = -6x^3 + 2x^2 + 7x^4 - 1$
7. $g(x) = \frac{1}{3}x^3 - \frac{\pi}{8}x^2 + x\sqrt{2} - 3^4$

1. $\lim_{x\to-\infty} f(x) = \infty \quad \lim_{x\to\infty} f(x) = -\infty$
2. $\lim_{x\to-\infty} g(x) = -\infty, \quad \lim_{x\to\infty} g(x) = \infty$
3. $\lim_{x\to-\infty} h(x) = -\infty \quad \lim_{x\to\infty} h(x) = \infty$
4. $\lim_{x\to-\infty} f(x) = -\infty \quad \lim_{x\to\infty} f(x) = -\infty$
5. $\lim_{x\to-\infty} g(x) = -\infty \quad \lim_{x\to\infty} g(x) = \infty$
6. $\lim_{x\to-\infty} f(x) = \infty \quad \lim_{x\to\infty} f(x) = -\infty$
7. $\lim_{x\to-\infty} g(x) = -\infty \quad \lim_{x\to\infty} g(x) = \infty$

Chapter 8

Dividing Polynomials

8.1 Dividing Polynomials

Divide each.

1. $(28x^3 - 26x^2 + 41x - 15) \div (7x - 3)$
2. $(44y^2 + 12y^3 + 61y - 37) \div (3y + 5)$
3. $\left(4x^3 - 3x^2 + x + 1\right) \div (x + 2)$
4. $\left(5x^4 - x^2 + x - 2\right) \div (x^2 + 2)$
5. $\left(10x^3 + 27x^2 + 8x - 11\right) \div (2x + 3)$
6. $\left(7x^3 + 23x^2 + 12x + 1\right) \div \left(x^2 + 3x + 1\right)$

8.2 Remainder and Factor Theorems

Determine the remainder of each.

1. $\left(2x^{53} - 9x^{44} + 13x^8\right) \div (x - 1)$
2. $\left(x^{71} + 15x^{58} - 3x^{14} + 2\right) \div (x + 1)$
3. $\left(x^{23} - 5x^{20} + 17x^8 - 5\right) \div (x + 2)$
4. $\left(-7x^{17} + 40x^{15} - 6x^8 + 4x^3\right) \div (x - 3)$

Dividing Polynomials

1. $4x^2 - 2x + 5$
2. $4y^2 + 8y + 7 - \dfrac{72}{3y + 5}$
3. $4x^2 - 11x + 23 - \dfrac{45}{x + 2}$
4. $5x^2 - 11 + \dfrac{x + 20}{x^2 + 2}$
5. $5x^2 + 6x - 5 + \dfrac{4}{2x + 3}$
6. $7x + 2 + \dfrac{-x - 1}{x^2 + 3x + 1}$

Remainder and Factor Theorems

1. 6
2. 13
3. $-13,627,141$
4. $-330,064,119$

Chapter 9

Rational Functions and Their Graphs

Find the domain, coordinates of any holes, and equations of all asymptotes.

1. $f(x) = \dfrac{2x^2 + 5x - 3}{2x^2 - 15x + 7}$
2. $g(x) = \dfrac{3x^3 + 7x^2 - 20x}{x^2 - x - 12}$
3. $f(x) = \dfrac{3x}{x + 4}$
4. $g(x) = \dfrac{x^2 + 3x + 2}{x - 1}$
5. $h(x) = \dfrac{x^2 + 3x - 4}{x^3 - 2x^2 + x}$
6. $f(x) = \dfrac{2x^3 - 13x^2 + 6x + 45}{x^2 - 4x - 5}$
7. $g(x) = \dfrac{5x^2 - 19x - 4}{x^3 + 2x^2 - 24x}$
8. $h(x) = \dfrac{2x^2 - x - 3}{8x^2 + 51x + 18}$
9. $f(x) = \dfrac{6x^3 - 21x^2 - 51x + 30}{3x^2 + 7x + 2}$
10. $g(x) = \dfrac{10x^2 - 29x - 21}{10x^3 - 33x^2 - 7x}$

State the end behavior of each.

11. $k(x) = \dfrac{5x^3 - 7x^2 + 8}{-3x^3 + 6x - 4}$
12. $m(x) = \dfrac{2x - 1}{3x^2 + 7x + 1}$

Rational Functions and Their Graphs Key

1. Domain: $x \neq -\frac{1}{2}$, 7; V.A.: $x = 7$; Hole @ $\left(-\frac{1}{2}, -\frac{7}{13}\right)$; H.A.: $y = 1$
2. Domain: $x \neq -3$, 4; V.A.: $x = -3\, x = 4$; Obl. Asymp: $y = 3x + 10$
3. Domain: $x \neq -4$; V.A.: $x = -4$; H.A.: $y = 3$
4. Domain: $x \neq 1$; V.A.: $x = 1$; Obl. Asymp: $y = x + 4$
5. Domain: $x \neq 0, 1$; V.A.: $x = 0$ and $x = 1$; H.A.: $y = 0$
6. Domain: $x \neq -1, 5$; V.A. $x = -1$; Hole @ $\left(5, \frac{13}{3}\right)$; Obl. Asym $y = 2x - 5$
7. Domain: $x \neq -6, 0, 4$; V.A. $x = -6$, $x = 0$; Hole @ $\left(4, \frac{21}{40}\right)$; H.A. $y = 0$
8. Domain: $x \neq -6, -\frac{3}{8}$; V.A. $x = -6$, $x = -\frac{3}{8}$; H.A. $y = \frac{1}{4}$
9. Domain: $x \neq -2$, $-\frac{1}{3}$; Hole @ $(-2, -21)$; V.A.: $x = -\frac{1}{3}$; S.A. $y = 2x - \frac{35}{3}$
10. Domain: $x \neq -\frac{1}{5}$, 0, $\frac{7}{2}$; Hole @ $\left(\frac{7}{2}, \frac{82}{259}\right)$; V.A. $x = -\frac{1}{5}$ and $x = 0$; H.A. $y = 0$
11. $\lim_{x \to -\infty} k(x) = \infty = \lim_{x \to \infty} k(x) = -\frac{5}{3}$
12. $\lim_{x \to -\infty} m(x) = \infty = \lim_{x \to \infty} m(x) = 0$

Chapter 10

Polynomial and Rational Inequalities

10.1 Polynomial Inequalities

Solve each. Write your answers using interval notation.

1. $6x^3 - 4x^2 - 10x \geq 0$
2. $x^4 < 9x^2$
3. $3x^3 - 7x^2 - 22x + 8 < 0$
4. $3x^2 - 4x + 1 \leq 0$
5. $12x^4 + 76x^3 + 43x^2 - 346x - 280 \geq 0$

10.2 Domain

State the domain of each. Write your answers using interval notation.

1. $b(x) = \sqrt{21x^2 - 23x - 20}$

10.3 Rational Inequalities

Solve each. Write your answers using interval notation.

1. $\dfrac{3x - 4}{x + 1} < 0$
2. $\dfrac{x^2 + 3x + 2}{x - 7} \leq 0$
3. $\dfrac{x^2 - 4x + 4}{x^2 - 1} \geq 0$
4. $\dfrac{x + 2}{x - 4} \leq 1$
5. $\dfrac{x^2 - 7x - 8}{x^2 - 4x - 32} \geq 0$
6. $\dfrac{4 + 3x}{5 - x} \leq 2$

Polynomial Inequalities

1. $[-1, 0] \cup \left[\frac{5}{3}, \infty\right)$
2. $(-3, 0) \cup (0, 3)$
3. $(-\infty, -2) \cup \left(\frac{1}{3}, 4\right)$
4. $\left[\frac{1}{3}, 1\right]$
5. $(-\infty, -4] \cup \left[-\frac{7}{2}, -\frac{5}{6}\right] \cup [2, \infty)$

Domain

1. $\left(-\infty, -\frac{12}{21}\right] \cup \left[\frac{5}{3}, \infty\right)$

Rational Inequalities

1. $\left(-1, \frac{4}{3}\right)$
2. $(-\infty, -2] \cup [-1, 7)$
3. $(-\infty, -1) \cup (1, \infty)$
4. $(-\infty, 4)$
5. $(-\infty, -4) \cup [-1, 8) \cup (8, \infty)$
6. $(-\infty, 1.2] \cup (5, \infty)$

Chapter 11

Function Compositions

Given $f(x) = x - 5$, $g(x) = 4 + \sqrt{2x+1}$, and $h(x) = \dfrac{3}{x+7}$, simplify each and state the domain.

1. $(f \circ g)(x)$
2. $(g \circ f)(x)$
3. $h(h(x))$

Find each of the following given the table below.

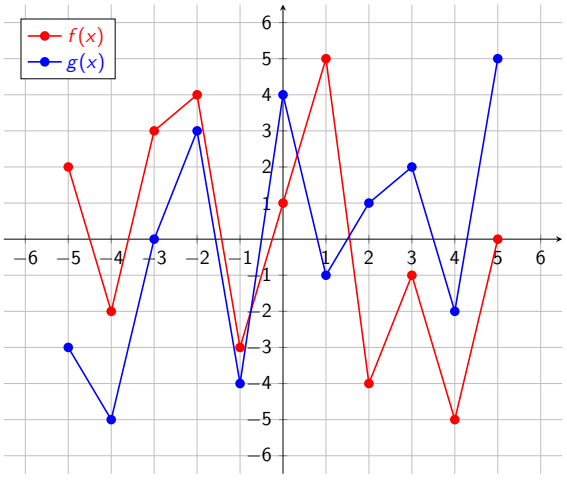
x	-4	-3	-2	-1	**0**	**1**	**2**	**3**	**4**
f(x)	-3	0	-1	3	1	2	4	-4	-2
g(x)	3	-1	0	1	4	-2	-4	2	-3

4. $(f \circ g)(-1)$
5. $(g \circ g)(0)$
6. $(f \circ f)(2)$
7. $(g \circ g)(-3)$
8. $f(g(0))$

Given $f(x) = \sqrt{3x+2}$, $g(x) = x^2 - 1$, and $h(x) = 9x - 2$, find each of the following.

9. $(g \circ f)(x)$
10. $f(g(x))$
11. $(h \circ h)(x)$

Find each of the following given the graphs of $f(x)$ (in red) and $g(x)$ (in blue) below:



12. $(f \circ g)(-1)$
13. $(g \circ f)(-4)$
14. $f(g(3))$
15. $g(g(-2))$
16. $(f \circ f)(-5)$

Function Compositions Key

1. $-1+\sqrt{2x+1}$ Domain: $\left[-\frac{1}{2},\infty\right)$
2. $4+\sqrt{2x-9}$ Domain: $\left[\frac{9}{2},\infty\right)$
3. $\frac{3x+21}{7x+52}$ Domain: $\left(-\infty,-\frac{52}{7}\right)\cup\left(-\frac{52}{7},-7\right)\cup(-7,\infty)$
4. 2
5. -3
6. -2
7. 1
8. -2
9. $3x+1$
10. $\sqrt{3x^2-1}$
11. $81x-20$
12. -2
13. 3
14. -4
15. 2
16. -4

Chapter 12

Inverse Functions

Find the inverse of each. Then state the domain and range of the function and the inverse.

1. $f(x) = \sqrt{-2x+3} + 1$
2. $g(x) = (x+4)^2 - 1,\ x \leq -4$
3. $h(x) = \dfrac{9x}{4x-1}$
4. $f(x) = \sqrt{x} - 3$
5. $g(x) = \dfrac{1}{1-x}$
6. $h(x) = x^2 + 6x + 4,\ x \leq -3$
7. $f(x) = \sqrt{5x-4}$
8. $g(x) = x^2 - 2x + 3,\ x \leq 1$
9. $h(x) = \dfrac{3}{x-1}$

Inverse Functions Key

1. $f^{-1}(x) = -\frac{1}{2}\left((x-1)^2 - 3\right)$

	Domain	Range
$f(x)$	$(-\infty, 1.5]$	$[1, \infty)$
$f^{-1}(x)$	$[1, \infty)$	$(-\infty, 1.5]$

2. $g^{-1}(x) = -\sqrt{x+1} - 4$

	Domain	Range
$g(x)$	$(-\infty, -4]$	$[-1, \infty)$
$g^{-1}(x)$	$[-1, \infty)$	$(-\infty, -4]$

3. $h^{-1}(x) = \frac{-x}{9-4x}$

	Domain	Range
$h(x)$	$(-\infty, 1/4) \cup (1/4, \infty)$	$(\infty, 9/4) \cup (9/4, \infty)$
$h^{-1}(x)$	$(\infty, 9/4) \cup (9/4, \infty)$	$(-\infty, 1/4) \cup (1/4, \infty)$

4. $f^{-1}(x) = (x+3)^2$

	Dom	Ran
$f(x)$	$[0, \infty)$	$[-3, \infty)$
$f^{-1}(x)$	$[-3, \infty)$	$[0, \infty)$

5. $g^{-1}(x) = 1 - \frac{1}{x}$

	Dom	Ran
$g(x)$	$(-\infty, 1) \cup (1, \infty)$	$(-\infty, 0) \cup (0, \infty)$
$g^{-1}(x)$	$(-\infty, 0) \cup (0, \infty)$	$(-\infty, 1) \cup (1, \infty)$

6. $h^{-1}(x) = -\sqrt{x+5} - 3$

	Dom	Ran
$h(x)$	$(-\infty, -3]$	$[-5, \infty)$
$h^{-1}(x)$	$[-5, \infty)$	$(-\infty, -3]$

7. $f^{-1}(x) = \frac{1}{5}x^2 + \frac{4}{5}$

	Dom	Ran
$f(x)$	$\left[\frac{4}{5}, \infty\right)$	$[0, \infty)$
$f^{-1}(x)$	$[0, \infty)$	$\left[\frac{4}{5}, \infty\right)$

8. $g^{-1}(x) = -\sqrt{x-2} + 1$

	Dom	Ran
$g(x)$	$(-\infty, 1]$	$[2, \infty)$
$g^{-1}(x)$	$[2, \infty)$	$(-\infty, 1]$

9. $h^{-1}(x) = \frac{3}{x} + 1$

	Dom	Ran
$h(x)$	$(-\infty, 1) \cup (1, \infty)$	$(-\infty, 0) \cup (0, \infty)$
$h^{-1}(x)$	$(-\infty, 0) \cup (0, \infty)$	$(-\infty, 1) \cup (1, \infty)$

Chapter 13

Exponential Functions

13.1 End Behavior

Determine the end behavior of each. Write your answers using limit notation.

1. $f(x) = 3 + e^{2x}$
2. $h(x) = 5^{-x}$
3. $h(x) = -\frac{2}{3}e^{x+7} + 1$
4. $f(x) = -7e^{x} + 4$
5. $g(x) = \frac{1}{3}e^{2x+1} - 5$
6. $h(x) = -\frac{1}{2}e^{-4x} + 1$

Exponential Functions

1. $\lim_{x\to-\infty} f(x) = 3 \quad \lim_{x\to\infty} f(x) = \infty$
2. $\lim_{x\to-\infty} f(x) = \infty \quad \lim_{x\to\infty} f(x) = 0$
3. $\lim_{x\to-\infty} h(x) = 1 \quad \lim_{x\to\infty} h(x) = -\infty$
4. $\lim_{x\to-\infty} f(x) = 4 \quad \lim_{x\to\infty} f(x) = -\infty$
5. $\lim_{x\to-\infty} f(x) = -5 \quad \lim_{x\to\infty} f(x) = \infty$
6. $\lim_{x\to-\infty} f(x) = -\infty \quad \lim_{x\to\infty} f(x) = 1$

Chapter 14

Logarithmic Functions

Write each of the following in exponential or logarithmic form.

1. $\ln(a) = 7$
2. $\log_4(x+1) = 9$
3. $\log(5x) = 30$
4. $\ln(w) = c$
5. $5^x = 19$
6. $8^{-3} = \dfrac{1}{512}$
7. $e^{14} = x$
8. $(1.1)^{-t} = 50$

Find the domain of each. Write your answers in interval notation.

9. $b(x) = \log_7\left(x^2 - 8x + 6\right)$
10. $a(x) = \ln\left(\dfrac{x^2+3x+2}{5x+15}\right)$
11. $f(x) = -7\ln\left(x^2 + 9x + 8\right)$
12. $g(x) = \log\left(5x^2 + 13x - 6\right)$
13. $h(x) = 3\log_2\left(x^3 + 2x^2 - x - 2\right)$
14. $c(x) = \ln\left(4x^2 - 15x - 4\right)$

State the end behavior of each.

15. $j(x) = 5\log_3(2x-5) - 2$

Logarithmic Functions Key

1. $e^7 = a$
2. $4^9 = x + 1$
3. $10^{30} = 5x$
4. $e^c = w$
5. $\log_5(19) = x$
6. $\log_8\left(\frac{1}{512}\right) = -3$
7. $\ln(x) = 14$
8. $\log_{1.1}(50) = -t$
9. $(-\infty, 0.838) \cup (7.162, \infty)$
10. $(-3, -2) \cup (-1, \infty)$
11. $(-\infty, -8) \cup (-1, \infty)$
12. $(-\infty, -3) \cup \left(\frac{2}{5}, \infty\right)$
13. $(-2, -1) \cup (1, \infty)$
14. $\left(-\infty, -\frac{1}{4}\right) \cup (4, \infty)$
15. $\lim_{x \to (5/2)^+} j(x) = -\infty \quad \lim_{x \to \infty} j(x) = \infty$

Chapter 15

Properties of Logarithms

Expand or condense each completely. Simplify numerical answers.

1. $\log_b\left(\frac{x^2}{y^8}\right)$
2. $\ln(ez)^3$
3. $\log_5(x) + \log_5(9) - 2\log_5(w)$

Write an equivalent expression for each of the following using natural logarithms.

4. $\log_7(10)$
5. $\log_9(x)$
6. $\log_b(c)$
7. $\log_3(10)$
8. $\log_{17}(\pi)$
9. $\log_w(x)$

Suppose that $\log_a(b) = 5$, $\log_a(c) = 12$, and $\log_a(d) = 9$. Evaluate each of the following.

10. $\log_a(bc)$
11. $\log_a(c^3)$
12. $\log_a\left(\frac{d}{c}\right)$
13. $\log_a\left(\frac{bd}{c}\right)$

Properties of Logarithms Key

1. $2\log_b(x) - 8\log_b(y)$
2. $3 + 3\ln(z)$
3. $\log_5\left(\frac{9x}{w^2}\right)$
4. $\frac{\ln(10)}{\ln(7)}$
5. $\frac{\ln(x)}{\ln(9)}$
6. $\frac{\ln(c)}{\ln(b)}$
7. $\frac{\ln(10)}{\ln(3)}$
8. $\frac{\ln(\pi)}{\ln(17)}$
9. $\frac{\ln(x)}{\ln(w)}$
10. 17
11. 36
12. -3
13. 2

Chapter 16

Exponential Equations

Solve each. Round to 3 decimal places when necessary.

1. $3e^{x-2} = 7$
2. $5^x + 4 > 1$
3. $2^{3x+4} = 32^{x-7}$
4. $5e^{7x} + 10 = 42$
5. $7^{4x+1} \geq 343$
6. $1000e^{0.04x} = 2000$
7. $3(4.1)^{x-2} = 8$
8. $2^{x+1} = 5^{7x-5}$

16.1 Applications

1. Plutonium has a half-life of 24,360 years. If 15 grams are initially present, how long until 9.5 grams remain?
2. Cadmium-109 has a half-life of about 1.267 years. If 50 mg are initially present, how many years will it take for 16 mg to remain?
3. The half-life of bismuth-207 is about 32.9 years. If 90 mg are initially present, how many years will it take for 75 mg to remain?

Exponential Equations Key

1. $x \approx 2.847$
2. $(-\infty, \infty)$
3. $x = 19.5$
4. $x \approx 0.265$
5. $\left[\frac{1}{2}, \infty\right)$
6. $x \approx 17.329$
7. $x \approx 2.695$
8. $x \approx 0.827$

Applications

1. Approximately 17,952 years
2. Approximately 2.0828 years
3. Approximately 8.6538 years

Chapter 17

Logarithmic Equations and Inequalities

Solve each. Round to 3 decimal places when necessary.

1. $\log_5(x) + x\log_5(x) > 0$
2. $\ln\left(8 - x^2\right) = \ln(2 - x)$
3. $\log_{25}\left(\frac{3x+1}{2x-2}\right) = \frac{1}{2}$
4. $\log_3(2x+1) - \log_3(x-5) = \log_3(x+1)$
5. $\log_4(x+1) + \log_4(x-5) > 2$
6. $\log(x+1) - \log(x-5) = \log(x-3)$
7. $x\log_3(x+2) - \log_3(x+2) = 0$
8. $\log_{1/2}(x+1) > -3$

Logarithmic Equations and Inequalities Key

1. $(1, \infty)$
2. $x = -2$
3. $x \approx 1.571$
4. $x \approx 6.873$
5. $(2, \infty)$
6. $x = 7$
7. $x = \pm 1$
8. $(-1, 7)$

Chapter 18

Sequences

Write the first 4 terms of each sequence.

1. $a_n = 2(-3)^n$
2. $b_n = \dfrac{n!}{2^n}$
3. $c_{n+1} = 5c_n + 1;\ c_1 = 2$
4. $d_n = \dfrac{1}{2}d_{n-1} + n;\ d_1 = 3$

Find the indicated term of each sequence. For term values above 10 billion or below 0.00001, write the first 4 digits after the decimal point when the answer is given in scientific notation. **Do not round**.

5. $a_n = \{343,\ 667,\ 991,\ 1315, \ldots\}$; Find the 582nd term.
6. $b_n = \{300,\ 240,\ 192, 153.6,\ \ldots\}$; Find the 711th term.
7. $c_n = \left\{1,\ \dfrac{1}{3},\ \dfrac{1}{5},\ \dfrac{1}{7},\ \ldots\right\}$; Find the 8,675,309th term.

Given each sequence, find the first 4 digits **after the decimal point** in the **scientific notation** version of each term.

8. $a_n = 17,\ 33,\ 49,\ 65,\ \ldots;\quad a_{21,972}$
9. $b_n = 25,\ 36,\ 49,\ 64,\ 81,\ \ldots\quad b_{413,401}$
10. $c_n = \dfrac{1}{3},\ \dfrac{1}{6},\ \dfrac{1}{12},\ \dfrac{1}{24},\ \ldots\quad c_{152}$

Sequences Key

1. -6, 18, -54, 162
2. $\frac{1}{2}$, $\frac{1}{2}$, $\frac{3}{4}$, $\frac{3}{2}$
3. 2, 11, 56, 281
4. 3, $\frac{7}{2}$, $\frac{19}{4}$, $\frac{51}{8}$
5. 188,587
6. 6882
7. 7634
8. 5155 (3.51553×10^{5})
9. 7090 ($1.7090369403 \times 10^{11}$)
10. 1677 ($1.1677487203 \times 10^{-46}$)

Chapter 19

Series

Find the sum of each, if possible.

1. $\sum_{i=1}^{\infty} \left(\frac{1}{5}\right)^i$
2. $\sum_{i=0}^{\infty} 3\left(-\frac{2}{3}\right)^i$
3. $\sum_{k=1}^{\infty} -2\left(\frac{1}{3}\right)^k$
4. $\sum_{j=0}^{\infty} -\frac{1}{2}\left(\frac{3}{2}\right)^j$
5. $\sum_{i=0}^{\infty} 1.2(0.8)^i$
6. $\sum_{i=1}^{\infty} 1.2(0.8)^i$
7. $\sum_{i=0}^{\infty} 0.8(1.2)^i$
8. $\sum_{k=1}^{\infty} \frac{2}{3^k}$

Find the sum of each of the following. Round to 4 decimal places when necessary.

9. $9 + 13 + 17 + 21 + \cdots + 1565$
10. $-3 + 6 - 12 + 24 - 48 + \cdots + 50,331,648$
11. $1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \cdots + \frac{1}{981}$
12. $2 + 4 + 6 + 8 + 10 + \cdots + 38,214$
13. $3 + 7 + 11 + 15 + \cdots + 11,491$
14. $\frac{4}{5} + \frac{5}{6} + \frac{6}{7} + \cdots + \frac{742}{743}$

Series Key

1. $\frac{1}{4}$
2. $\frac{9}{5}$
3. -1
4. Diverges
5. 6
6. 4.8
7. Diverges
8. 2
9. 306,930
10. $-33,554,433$
11. 7.4663
12. 365,096,556
13. 16,511,131
14. 733.8947

Chapter 20

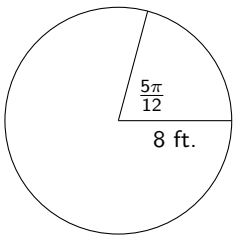
Angles and Radian Measure

Sketch each of the following. Then find a coterminal between 0 and 360° (or 0 and 2π radians) for each.

1. $-\frac{3\pi}{4}$
2. 900°
3. $\frac{27\pi}{10}$
4. -125°

Find the arc length and sector area formed by the central angle of each. Exact answers only.

5.



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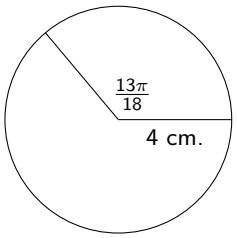

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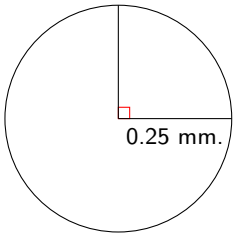
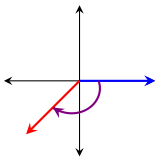


A belt runs on a pulley with radius 4 inches at 250 revolutions per minute.

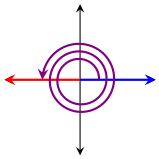
8. Find the angular velocity in rad/sec. Round your answer to 2 decimal places.
9. Find the linear velocity in ft/sec. Round your answer to 2 decimal places.

Angles and Radian Measure Key

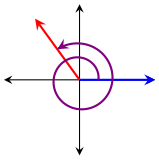
1. $\frac{5\pi}{4}$



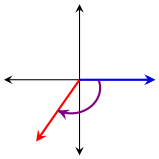
2. 180°



3. $\frac{7\pi}{10}$



4. 235°



5. $s = \frac{10\pi}{3}$ ft.; $A = \frac{40\pi}{3}$ sq.ft.
6. $s = \frac{26\pi}{9}$ cm.; $A = \frac{52\pi}{9}$ sq.cm.
7. $s = \frac{\pi}{8}$ mm.; $A = \frac{\pi}{64}$ sq.mm.
8. 26.18 rad/sec
9. 8.73 ft/sec

Chapter 21

Trig Functions of Any Angle

Find the exact value of each of the six trig functions of θ if P is a point on the terminal side of θ.

1. $P(-2, 3)$
2. $P(0, -4)$
3. $P(-2\sqrt{3}, 2)$
4. $P(-3, 5)$
5. $P(-2, 1)$
6. $P(-4, -7)$

Find the exact values of the 6 trig functions of the following angles.

7. $\theta = \dfrac{-17\pi}{4}$
8. $\theta = \dfrac{21\pi}{2}$
9. $\theta = 24\pi$

Trig Functions of Any Angle Key

1. $\sin\theta = \dfrac{3\sqrt{13}}{13}$, $\cos\theta = \dfrac{-2\sqrt{13}}{13}$, $\tan\theta = -\dfrac{3}{2}$, $\csc\theta = \dfrac{\sqrt{13}}{3}$, $\sec\theta = -\dfrac{\sqrt{13}}{2}$, $\cot\theta = -\dfrac{2}{3}$
2. $\sin\theta = -1$, $\cos\theta = 0$, $\tan\theta =$ undef., $\csc\theta = -1$, $\sec\theta =$ undef., $\cot\theta = 0$
3. $\sin\theta = \dfrac{1}{2}$, $\cos\theta = -\dfrac{\sqrt{3}}{2}$, $\tan\theta = -\dfrac{\sqrt{3}}{3}$, $\csc\theta = 2$, $\sec\theta = -\dfrac{2\sqrt{3}}{3}$, $\cot\theta = -\sqrt{3}$
4. $\sin\theta = \dfrac{5\sqrt{34}}{34}$, $\cos\theta = -\dfrac{3\sqrt{34}}{34}$, $\tan\theta = -\dfrac{5}{3}$, $\csc\theta = \dfrac{\sqrt{34}}{5}$, $\sec\theta = -\dfrac{\sqrt{34}}{3}$, $\cot\theta = -\dfrac{3}{5}$
5. $\sin\theta = \dfrac{\sqrt{5}}{5}$, $\cos\theta = -\dfrac{2\sqrt{5}}{5}$, $\tan\theta = -\dfrac{1}{2}$, $\csc\theta = \sqrt{5}$, $\sec\theta = -\dfrac{\sqrt{5}}{2}$, $\cot\theta = -2$
6. $\sin\theta = -\dfrac{7\sqrt{65}}{65}$, $\cos\theta = -\dfrac{4\sqrt{65}}{65}$, $\tan\theta = \dfrac{7}{4}$, $\csc\theta = -\dfrac{\sqrt{65}}{7}$, $\sec\theta = -\dfrac{\sqrt{65}}{4}$, $\cot\theta = \dfrac{4}{7}$
7. $\sin\theta = -\dfrac{\sqrt{2}}{2}$, $\cos\theta = \dfrac{\sqrt{2}}{2}$, $\tan\theta = -1$, $\csc\theta = -\sqrt{2}$, $\sec\theta = \sqrt{2}$, $\cot\theta = -1$
8. $\sin\theta = 1$, $\cos\theta = 0$, $\tan\theta =$ undefined, $\csc\theta = 1$, $\sec\theta =$ undefined, $\cot\theta = 0$
9. $\sin\theta = 0$, $\cos\theta = 1$, $\tan\theta = 0$, $\csc\theta =$ undefined, $\sec\theta = 1$, $\cot\theta =$ undefined

Chapter 22

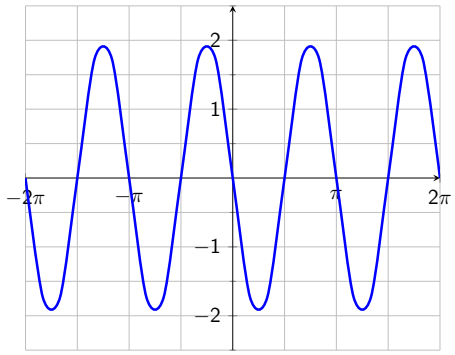
Graphs of Sine and Cosine Functions

Determine the amplitude, period, phase shift, and vertical shift for each. Exact answers only.

1. $f(x) = -2\sin\left(3x - \frac{\pi}{4}\right) + 1$
2. $g(x) = \frac{1}{3}\cos\left(\frac{1}{2}x + 2\right)$
3. $f(x) = 2\sin\left(x - \frac{\pi}{3}\right) + 7$
4. $f(x) = -4\cos\left(\frac{2}{3}x - \frac{2\pi}{3}\right)$

Write the equation of each of the following in the form $y = a\sin(bx)$.

5.



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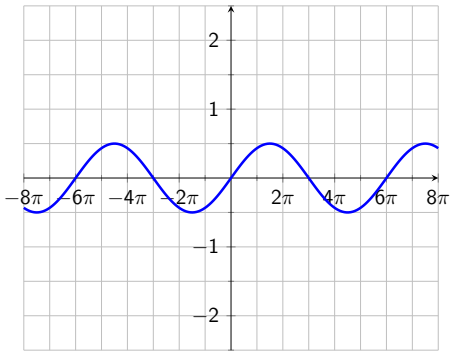


Answers

1. Amp $= 2$, Per $= \dfrac{2\pi}{3}$, P.S. $= \dfrac{\pi}{12}\,\rightarrow$, V.S. $= 1\,\uparrow$
2. Amp $= \dfrac{1}{3}$, Per $= 4\pi$, P.S. $= 4\,\leftarrow$, V.S. $=$ None
3. Amp $= 2$, Period $= 2\pi$, P.S. $= \dfrac{\pi}{3}$ right, V.S. $= 7$ up
4. Amp $= 4$, Period $= 3\pi$, P.S. $= \pi$ right, V.S. $= 0$ (or none)
5. $y = -2\sin(2x)$
6. $y = \dfrac{1}{2}\sin\left(\dfrac{1}{3}x\right)$

Chapter 23

Graphs of Other Trig Functions

Determine the amplitude, period, phase shift, and vertical shift for each. Exact answers only.

1. $h(x) = \tan\left(\frac{3}{4}x + \frac{\pi}{12}\right) - 8$
2. $f(x) = 3\tan\left(2x + \frac{\pi}{2}\right) - \sqrt{3}$

Graphs of Other Trig Functions Key

1. Amp = n/a, Per = $\frac{4\pi}{3}$, P.S. = $\frac{\pi}{9}\leftarrow$, V.S. = $8\downarrow$
2. Amp = n/a, Period = $\frac{\pi}{2}$, P.S. = $\frac{\pi}{4}$ left, V.S. = $\sqrt{3}$ down

Chapter 24

Inverse Trig Functions

State the exact, simplified value of each or write as an expression of x.

1. $\tan^{-1}\left(-\sqrt{3}\right)$
2. $\sec\left(\sin^{-1}\left(\frac{2}{5}\right)\right)$
3. $\cot\left(\sec^{-1}(x)\right)$
4. $\sin\left(\cos^{-1}\left(\frac{3x}{4}\right)\right)$
5. $\cot\left(\csc^{-1}\left(-\frac{7}{2}\right)\right)$
6. $\sec\left(\arcsin\left(\frac{9}{13}\right)\right)$
7. $\cos\left(\tan^{-1}(7x)\right)$
8. $\sin\left(\sec^{-1}\left(\frac{8}{x}\right)\right)$

Inverse Trig Functions Key

1. $-\frac{\pi}{3}$
2. $\frac{5\sqrt{21}}{21}$
3. $\frac{1}{\sqrt{x^2-1}} = \frac{\sqrt{x^2-1}}{x^2-1}$
4. $\frac{\sqrt{16-9x^2}}{4}$
5. $-\frac{3\sqrt{5}}{2}$
6. $\frac{13\sqrt{22}}{44}$
7. $\frac{\sqrt{49x^2+1}}{49x^2+1}$
8. $\frac{\sqrt{64-x^2}}{x}$

Chapter 25

Trig Equations and Inequalities

Solve each in the interval $[0, 2\pi)$. Write your answers to inequalities using interval notation.

1. $\tan(6x) = 1$
2. $\cot(2x) = -\dfrac{\sqrt{3}}{3}$
3. $\sin^2(x) = \dfrac{3}{4}$
4. $\sin(2x) = \cos(x)$
5. $\sin(2x) \geq \sin(x)$
6. $\cos(2x) < 0$
7. $2\sin\left(x - \dfrac{\pi}{3}\right) = -1$
8. $3\tan\left(-2x + \dfrac{\pi}{2}\right) = \sqrt{3}$
9. $\sin^2(x) < \dfrac{1}{2}$

Trig Equations and Inequalities Key

1. $\frac{\pi}{24}, \frac{5\pi}{24}, \frac{3\pi}{8}, \frac{13\pi}{24}, \frac{17\pi}{24}, \frac{7\pi}{8}, \frac{25\pi}{24}, \frac{29\pi}{24}, \frac{11\pi}{8}, \frac{37\pi}{24}, \frac{41\pi}{24}, \frac{15\pi}{8}$
2. $\frac{\pi}{3}, \frac{5\pi}{6}, \frac{4\pi}{3}, \frac{11\pi}{6}$
3. $\frac{\pi}{3}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3}$
4. $\frac{\pi}{2}, \frac{5\pi}{6}, \frac{3\pi}{2}$
5. $\left[0, \frac{\pi}{3}\right] \cup \left[\pi, \frac{5\pi}{3}\right]$
6. $\left(\frac{\pi}{4}, \frac{3\pi}{4}\right) \cup \left(\frac{5\pi}{4}, \frac{7\pi}{4}\right)$
7. $x = \frac{\pi}{6}, \frac{3\pi}{2}$
8. $x = \frac{\pi}{6}, \frac{2\pi}{3}, \frac{7\pi}{6}, \frac{5\pi}{3}$
9. $\left[0, \frac{\pi}{4}\right) \cup \left(\frac{3\pi}{4}, \frac{5\pi}{4}\right) \cup \left(\frac{7\pi}{4}, 2\pi\right)$

Chapter 26

Law of Sines and Cosines

Solve each of the following. Round your answers to 1 decimal place.

1. $m\angle B = 37.8^\circ$, $a = 15$, $c = 21.1$
2. $m\angle A = 41.9^\circ$, $m\angle C = 59.2^\circ$, $a = 10.2$
3. $a = 14$, $b = 19.6$, $c = 13.1$

Law of Sines and Cosines Key

1. $b \approx 13.0$, $m\angle A \approx 44.8^\circ$, $m\angle C \approx 97.4^\circ$
2. $m\angle B = 78.9^\circ$, $b \approx 15.0$, $c \approx 13.1$
3. $m\angle A \approx 45.5^\circ$, $m\angle B \approx 92.6^\circ$, $m\angle C \approx 41.9^\circ$

Chapter 27

Area of Triangles

Find the area of each. Round your answers to 1 decimal place.

1. $m\angle B = 37.8^\circ$, $a = 15$, $c = 21.1$
2. $m\angle A = 41.9^\circ$, $m\angle C = 59.2^\circ$, $a = 10.2$
3. $a = 14$, $b = 19.6$, $c = 13.1$

Area of Triangles Key

1. Approximately 97.0 sq. units
2. Approximately 65.7 sq. units
3. Approximately 91.6 sq. units

Chapter 28

Polar Coordinates

Convert each to exact rectangular coordinates.

1. $\left(3, \frac{5\pi}{6}\right)$
2. $\left(-2, -\frac{\pi}{4}\right)$
3. $\left(\frac{5}{2}, 240^\circ\right)$

Convert each to exact polar coordinates. Use $r > 0$ and $0 \leq \theta < 2\pi$.

4. $\left(-2\sqrt{3}, -2\right)$
5. $\left(-\frac{1}{2}, \frac{1}{2}\right)$
6. $\left(7\sqrt{2}, -7\sqrt{2}\right)$

Convert each to either rectangular or polar coordinates.

7. $2x + 5y = 9$
8. $3y = 1$
9. $-5x - 8y = -10$
10. $r = 8$
11. $r = 4\sec(\theta)$
12. $\theta = -\frac{\pi}{6}$

Polar Coordinates Key

1. $\left(-\frac{3\sqrt{3}}{2}, \frac{3}{2}\right)$
2. $(-\sqrt{2}, \sqrt{2})$
3. $\left(\frac{5}{4}, \frac{5\sqrt{3}}{4}\right)$
4. $\left(4, \frac{7\pi}{6}\right)$
5. $\left(\frac{\sqrt{2}}{2}, \frac{3\pi}{4}\right)$
6. $\left(14, \frac{7\pi}{4}\right)$
7. $r = \frac{9}{2\cos\theta + 5\sin\theta}$
8. $r = \frac{1}{3}\csc\theta$
9. $r = \frac{10}{5\cos\theta + 8\sin\theta}$
10. $x^2 + y^2 = 64$
11. $x = 4$
12. $y = -\frac{\sqrt{3}}{3}x$

Chapter 29

Vectors

[*Vectors*] Given $\vec{v} = 3\mathbf{i} - 5\mathbf{j}$ and $\vec{w} = \langle -2, 1 \rangle$, find each. Exact and simplified answers only.

1. $\vec{v} + \vec{w}$
2. $-4\vec{w}$
3. $|v|$
4. $\hat{w}$

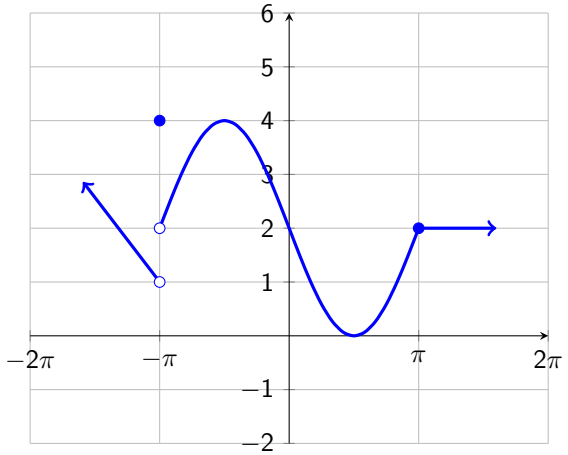
Vectors Key

1. $\mathbf{i} - 4\mathbf{j}$
2. $\langle 8, -4 \rangle$
3. $\sqrt{34}$
4. $\left\langle -\frac{2\sqrt{5}}{5}, \frac{\sqrt{5}}{5} \right\rangle$

Chapter 30

Numerical and Graphical Limits

Solve using the graph of $f(x)$ below.



1. $\lim_{x \to -\pi^-} f(x)$
2. $\lim_{x \to -\pi^+} f(x)$
3. $\lim_{x \to -\pi} f(x)$
4. $f(-\pi)$
5. $\lim_{x \to \pi^-} f(x)$
6. $\lim_{x \to \pi^+} f(x)$
7. $\lim_{x \to \pi} f(x)$
8. $f(\pi)$

Numerical and Graphical Limits Key

1. 1
2. 2
3. Does not exist
4. 4
5. 2
6. 2
7. 2
8. 2

Appendix A

Factoring

Factor each of the following completely.

1. $x^2 + 2x - 15$
2. $x^2 - 8x + 12$
3. $x^2 + 15x + 56$
4. $5x^2 + 19x - 4$
5. $4x^2 - 5x - 6$
6. $9x^2 - 400$
7. $5x^2 - 7x - 6$
8. $9x^2 - 54x + 45$
9. $3x^3 + 12x^2 + 9x$
10. $9y^2 - 16$
11. $4x^2 - 28x + 49$
12. $14x^2 + 11xy - 15y^2$
13. $6x^2 - 48x - 120$
14. $9x^4 - 54x^3 + 45x^2$
15. $16y^2 - 40y + 25$
16. $30x^2 + xy - y^2$
17. $8w^2 + 33w + 4$
18. $3p^2 + 22p - 16$
19. $18x^2 - 27x + 4$
20. $14a^2 + 15a - 9$
21. $4x^2 - 4x - 24$
22. $18t^2 - 9t - 5$
23. $6a^2 + 23a + 21$
24. $25x^2 - 1$

Factoring Key

1. $(x+5)(x-3)$
2. $(x-6)(x-2)$
3. $(x+7)(x+8)$
4. $(5x-1)(x+4)$
5. $(4x+3)(x-2)$
6. $(3x+20)(3x-20)$
7. $(5x+3)(x-2)$
8. $9(x-5)(x-1)$
9. $3x(x+3)(x+1)$
10. $(3y+4)(3y-4)$
11. $(2x-7)^2$
12. $(7x-5y)(2x+3y)$
13. $6(x-10)(x+2)$
14. $9x^2(x-1)(x-5)$
15. $(4y-5)^2$
16. $(6x-y)(5x+y)$
17. $(8w+1)(w+4)$
18. $(3p-2)(p+8)$
19. $(6x-1)(3x-4)$
20. $(7a-3)(2a+3)$
21. $4(x-3)(x+2)$
22. $(6t-5)(3t+1)$
23. $(2a+3)(3a+7)$
24. $(5x+1)(5x-1)$

Appendix B

Complex Fractions

Simplify each as much as possible.

1. $\dfrac{5+\frac{3}{x}}{x-\frac{1}{2}}$
2. $\dfrac{\frac{1}{x}+\frac{2}{x^2}}{x+\frac{8}{x^2}}$
3. $\dfrac{3}{2-\frac{x}{x-1}}$
4. $\dfrac{1+\frac{3}{x}}{\frac{2}{x}+7}$
5. $\dfrac{\frac{4}{x}-\frac{x}{x-2}}{\frac{1}{x}+\frac{3}{x-2}}$
6. $\dfrac{\frac{3}{x+1}-4}{\frac{2}{x+1}}$
7. $\dfrac{\frac{5}{x}+\frac{3}{x-2}}{\frac{7}{x^2-2x}}$
8. $\dfrac{\frac{1}{x}-\frac{1}{7}}{x-7}$
9. $\dfrac{\frac{1}{x}+\frac{1}{x+1}}{5}$
10. $\dfrac{\frac{5}{x}-5x}{x-1}$
11. $\dfrac{\frac{1}{2+x}-\frac{1}{2}}{x}$
12. $\dfrac{\frac{3}{x-4}+\frac{2x}{x+1}}{4x}$
13. $\dfrac{\frac{1}{x-a}+\frac{1}{a}}{x}$
14. $\dfrac{\frac{1}{x-1}-\frac{1}{x-3}}{\frac{2}{x-1}+\frac{3}{x+1}}$
15. $\dfrac{\frac{2}{x^2-4}+\frac{1}{x-2}}{\frac{4}{x+2}}$

Complex Fractions Key

1. $\frac{2(5x+3)}{x(2x-1)}$
2. $\frac{1}{x^2-2x+4}$
3. $\frac{3(x-1)}{x-2}$
4. $\frac{x+3}{2+7x}$
5. $\frac{-1(x^2-4x+8)}{2(2x-1)}$
6. $\frac{-4x-1}{2}$
7. $\frac{8x-10}{7}$
8. $-\frac{1}{7x}$
9. $\frac{2x+1}{5x(x+1)}$
10. $\frac{-5x-5}{x}$
11. $\frac{-1}{2x+4}$
12. $\frac{(x-1)(2x-3)}{4x(x-4)(x+1)}$
13. $\frac{1}{a(x-a)}$
14. $\frac{-2x-2}{5x^2-16x+3}$
15. $\frac{x+4}{4x-8}$