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Unit 1 Functions and Relations Review Guide

Determine each relation if it is a function.

1.

x	1	2	2	-2
y	4	-4	8	-8

2. $R = \{(-1, 2); (0, 3); (1, 9); (2, 0)\}$

Evaluate each function.

3. $f(x) = \dfrac{5x - 6}{2x - 5}$ $\quad f(3) = ?$

4. $f(x) = \dfrac{x^2 + 2x - 2}{3x}$ $\quad f(-2) = ?$

5. $h(x) = 13 - \sqrt{x^3 + 17}$ $\quad h(4) = ?$

6. $g(t) = \sqrt{t + 2t^2}$ $\quad g(3z) = ?$

State the domain of each function. Write in interval notation.

7. $g(x) = \dfrac{1}{x + 4}$

8. $h(x) = \sqrt{7x - 14}$

9. $g(t) = \dfrac{2}{t} + \dfrac{1}{t - 1}$

10. $h(x) = \dfrac{x^2}{\sqrt{x - 2}}$

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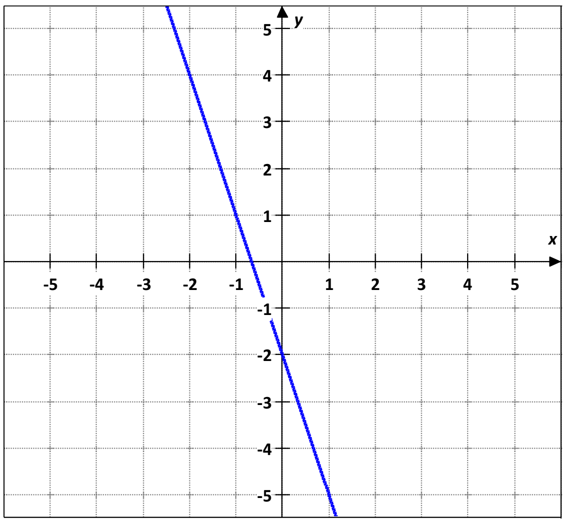
Unit 1 Functions and Relations Review Guide

Use a graph of each function to estimate the indicated function values.

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

$f(-1) = ?$ $f(0) = ?$ $f(1) = ?$

Graphically

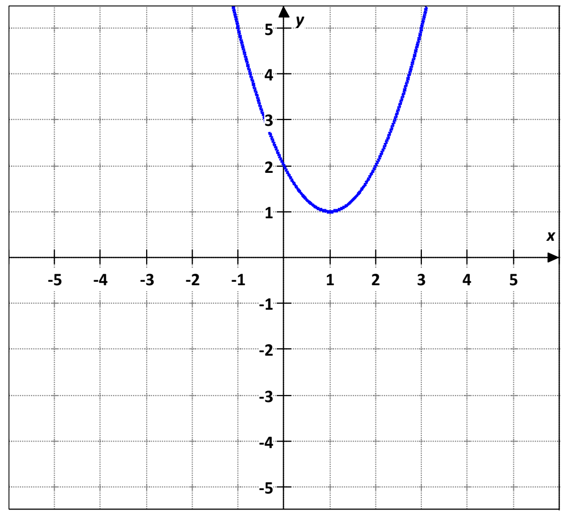


Algebraically

12. $f(x) = x^2 - 2x + 2$

$f(-1) = ?$ $f(0) = ?$ $f(2) = ?$

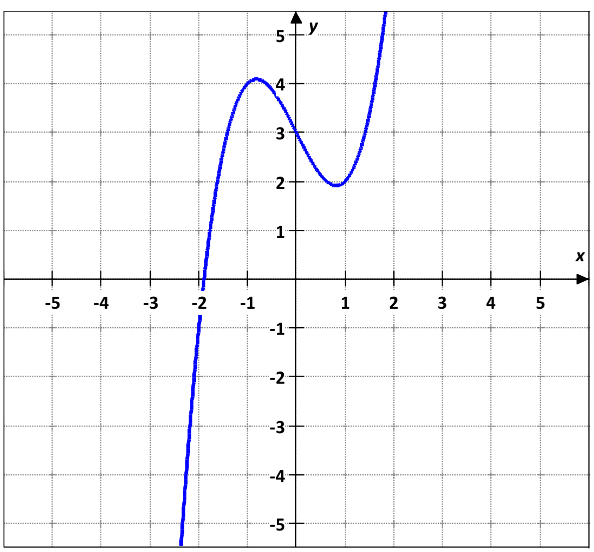
Graphically



Algebraically

Use the graph of each function to approximate its y –intercept. Then find the y –intercept algebraically.

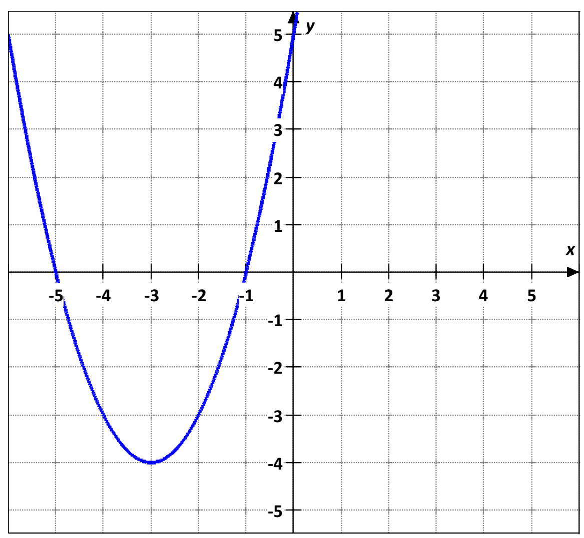
13. $f(x) = x^3 - 2x + 3$



Graphically

Algebraically

14. $f(x) = (x + 3)^2 - 4$



Graphically

Algebraically

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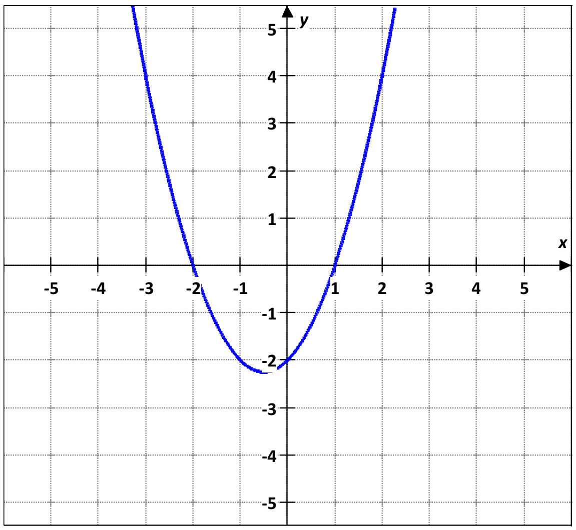
Unit 1 Functions and Relations Review Guide

Use the graph of each function to approximate its zeros. Then find the zeros of each function algebraically.

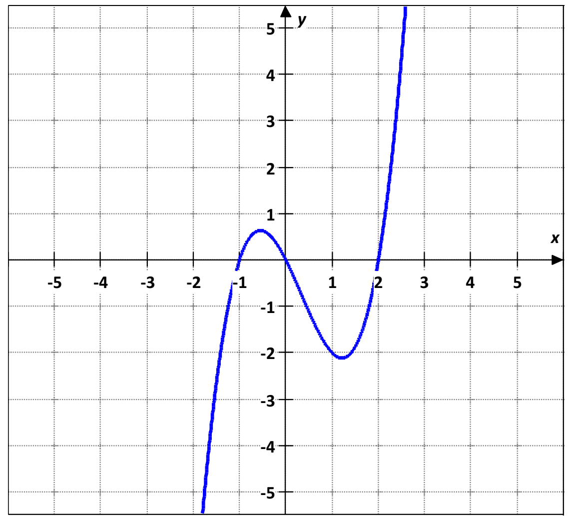
15. $f(x) = x^2 + x - 2$



Graphically

Algebraically

16. $f(x) = x^3 + x^2 - 2x$

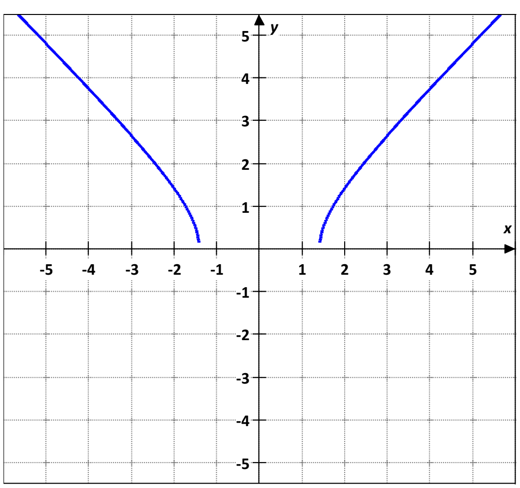


Graphically

Algebraically

Use the graph of function to test for symmetry with respect to the x -axis, y -axis, and the origin. Support the answer numerically. Then confirm algebraically.

17. $y = \sqrt{x^2 - 2}$



Graphically

Support Numerically

x				
y				
(x, y)				

Algebraically

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Unit 1 Functions and Relations Review Guide

Determine whether the following are even, odd, or neither.

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

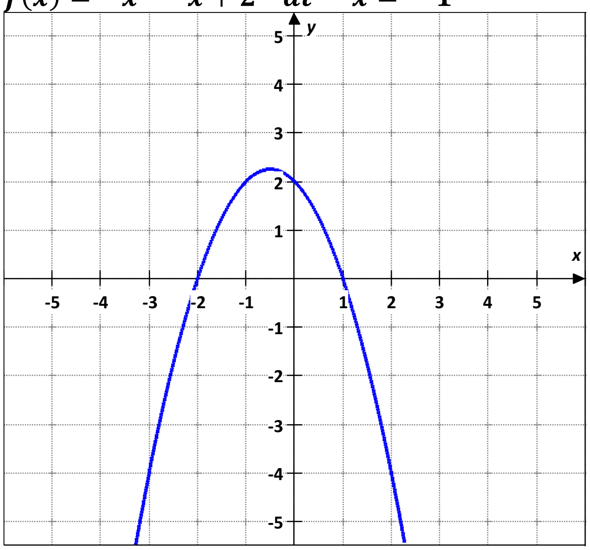
19. $h(x) = 2x^4 - x^3 - 3x + 2$

20. $g(x) = x^4 - 7x^2$

21. $h(x) = \dfrac{1}{x^2 - 7}$

Determine whether the function is continuous at the given x -value. Justify using the continuity test.

22. $f(x) = -x^2 - x + 2 \quad at \quad x = -1$



Find the value of k so that $f(x)$ is continuous.

23. $f(x) = \begin{cases} 2kx - 6 & if\ x > 2 \\ x + 3k & if\ x \leq 2 \end{cases}$

24. $f(x) = \begin{cases} 5kx + 1 & if\ x > 5 \\ 3x - 2k & if\ x \leq 5 \end{cases}$

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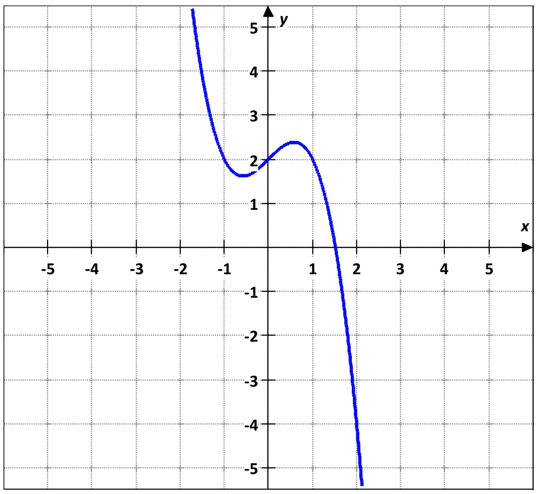
Unit 1 Functions and Relations Review Guide

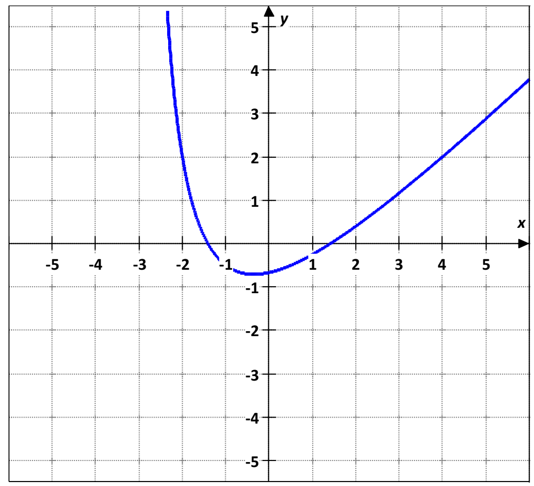
Determine between which consecutive integers the real zeros of function are located on the given interval.

25. $f(x) = -x^3 + x + 2 \quad [-1, 3]$



x					
y					

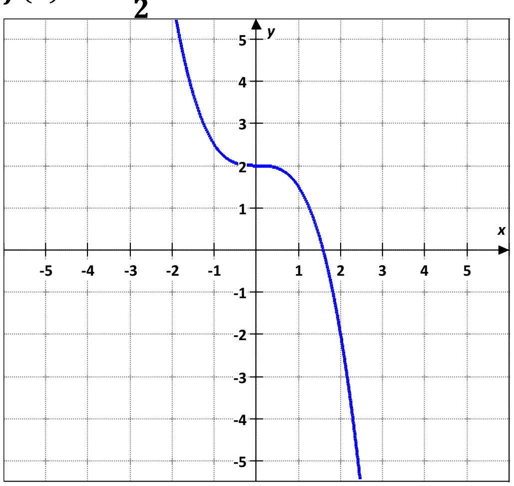
26. $f(x) = \dfrac{x^2 - 2}{x + 3} \quad [-3, 3]$



x							
y							

Use the graph of the function to describe its end behavior. Support the conjecture numerically.

27. $f(x) = -\dfrac{1}{2}x^3 + 2$



x					
y					

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Unit 1 Functions and Relations Review Guide

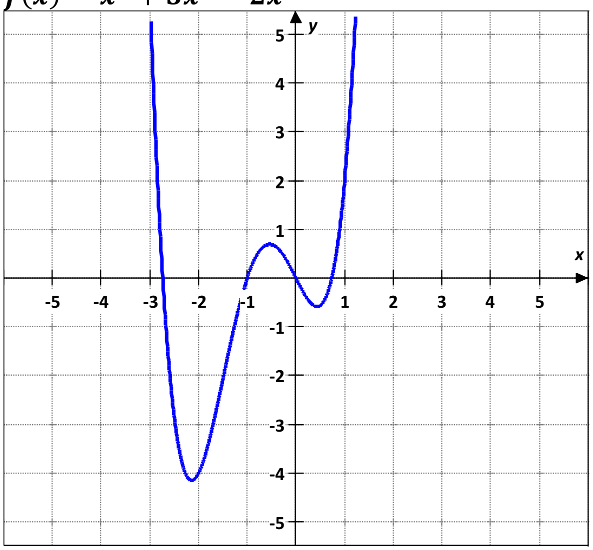
Evaluate the following limits.

28. $\lim_{x\to 4} = \frac{x^2-16}{x-4} = ?$

29. $\lim_{x\to -1} x^2+6x-3 = ?$

Estimate and classify the extrema for the graph of the function. Support the answers numerically.

30. $f(x)=x^4+3x^3-2x$



Find the average rate of change of each function on the given interval.

31. $f(x)=3x+4 \quad [1;2]$

32. $f(x)=x^2+3 \quad [1;0]$

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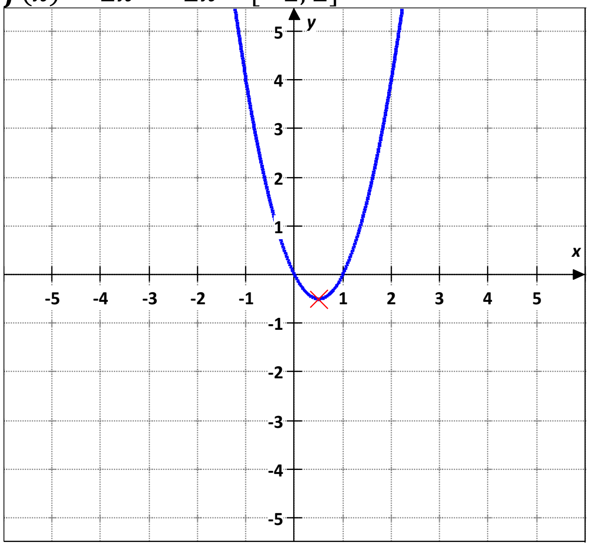
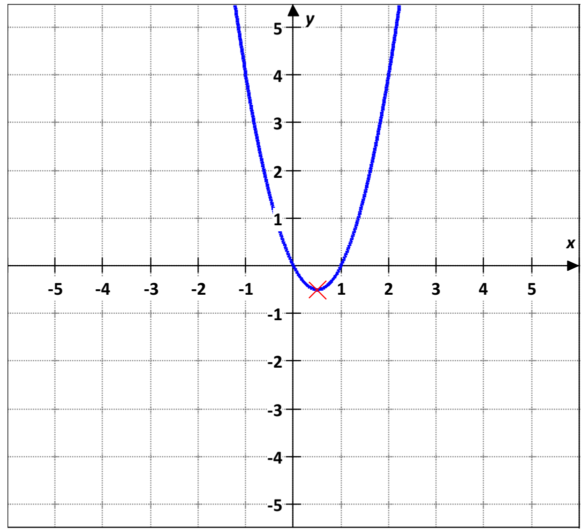
Unit 1 Functions and Relations **Review Guide**

33. $f(x) = 2x^2 - 2x \quad [-1; 2]$





Identify the parent function and describe the transformations.

34. $f(x) = (x - 1)^2 - 2$

Parent :
Transformation:

35. $f(x) = -|x - 4|$

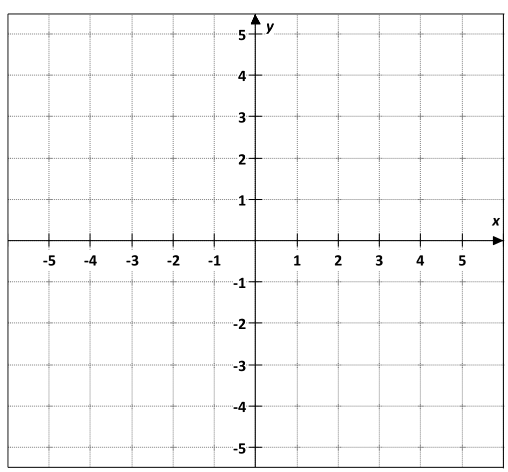
Parent :
Transformation:

36. $f(x) = \sqrt{x + 3} + 6$

Parent :
Transformation:

Use the graph of parent function to graph each function. Find the domain and the range of the new function.

37. $g(x) = \dfrac{3}{x + 2} - 1$



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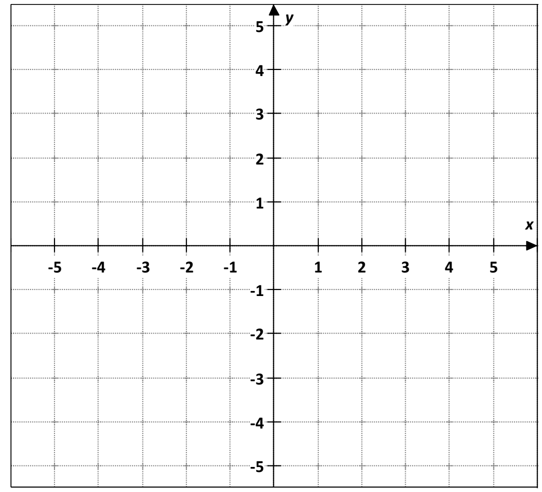
Unit 1 Functions and Relations Review Guide

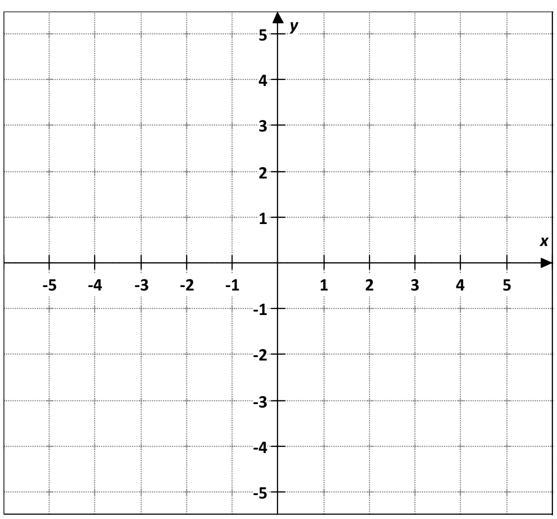
38. $g(x) = -|x - 3| - 1$

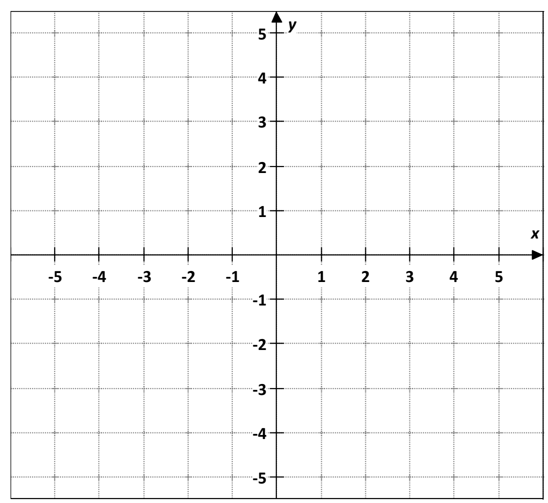


Graph each piecewise function.

39. $f(x) = \begin{cases} |x| & \text{if } x < -2 \\ -x^2 + 2 & \text{if } -2 < x < 2 \\ 2x - 3 & \text{if } x \geq 2 \end{cases}$

40. $f(x) = \begin{cases} \sqrt{x + 5} & \text{if } x \leq -1 \\ -x + 2 & \text{if } -1 < x < 2 \\ x^2 - 4 & \text{if } x \geq 2 \end{cases}$





Find $(f+g)(x)$, $(f-g)(x)$, $(f * g)(x)$, and $\left(\frac{f}{g}\right)(x)$ for each $f(x)$ and $g(x)$. Determine the domain of each new function.

41. $f(x) = 2x + 6$ $\qquad g(x) = x - 1$

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42. $f(x) = 2x^3$ $g(x) = x^2 - 1$

Find each composite function. Determine the domain of each composite function.

43. $f(x) = x^2 - 3$ $g(x) = x - 3$
$(f \circ g)(x) = ?$ $D_{f \circ g} = ?$

44. $f(x) = \sqrt{x+3}$ $g(x) = x^2 - 1$
$(g \circ f)(x) = ?$ $D_{g \circ f} = ?$

Find and then evaluate each composite function.

45. $f(x) = \sqrt{3 - x}$ $g(x) = x^2 + 2$
$(f \circ g)(-1) = ?$

46. $f(x) = \frac{7}{x}$ $g(x) = \frac{x}{4}$
$(g \circ f)(7) = ?$

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Unit 1 Functions and Relations Review Guide

Express $h(x)$ as a composition of two functions f and $(f \circ g)(x)$.

47. $h(x) = \sqrt[4]{x^2 + 4}$

48. $h(x) = (x - 24)^5$

Find an equation for the inverse of each of the one to one function.

49. $f(x) = 2x + 7$

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

Show algebraically that f and g are inverse functions.

51. $f(x) = \dfrac{x - 2}{4}$ $\quad g(x) = 4x + 2$

52. $f(x) = \sqrt{x + 2} - 3$
$g(x) = (x + 3)^2 - 2 \quad x \geq -3$

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Unit 1 Functions and Relations Review Guide

ANSWERS

Determine each relation if it is a function.

1.

x	1	2	2	-2
y	4	-4	8	-8

The relation is **NOT A FUNCTION** because input 2 has two different outputs.

2. $R = \{(-1, 2); (0, 3); (1, 9); (2, 0)\}$

Each input value **HAS** unique output.
The relation is **A FUNCTION**.

Evaluate each function.

3. $f(x) = \dfrac{5x - 6}{2x - 5}$ $\quad f(3) = ?$

$f(3) = \dfrac{5 * 3 - 6}{2 * 3 - 5}$

$f(3) = \dfrac{15 - 6}{6 - 5}$

$f(3) = 9$

4. $f(x) = \dfrac{x^2 + 2x - 2}{3x}$ $\quad f(-2) = ?$

$f(-2) = \dfrac{x^2 + 2x - 2}{3x}$

$f(-2) = \dfrac{(-2)^2 + 2 * (-2) - 2}{3 * (-2)}$

$f(-2) = \dfrac{4 - 4 - 2}{-6}$

$f(-2) = \dfrac{1}{3}$

5. $h(x) = 13 - \sqrt{x^3 + 17}$ $\quad h(4) = ?$

$h(4) = 13 - \sqrt{4^3 + 17}$

$h(4) = 13 - \sqrt{64 + 17}$

$h(4) = 13 - \sqrt{81}$

$h(4) = 13 - 9$

$h(4) = 4$

6. $g(t) = \sqrt{t + 2t^2}$ $\quad g(3z) = ?$

$g(3z) = \sqrt{3z + 2 * (3z)^2}$

$g(3z) = \sqrt{3z + 2 * 9z^2}$

$g(3z) = \sqrt{3z + 18z^2}$

State the domain of each function. Write in interval notation.

7. $g(x) = \dfrac{1}{x + 4}$

$x + 4 \neq 0$

$x \neq -4$

$Domain = (-\infty, -4) \cup (-4, \infty)$

8. $h(x) = \sqrt{7x - 14}$

$7x - 14 \geq 0$

$7x \geq 14$

$x \geq 2$

$Domain = [2, \infty)$

9. $g(t) = \dfrac{2}{t} + \dfrac{1}{t - 1}$

$t \neq 0$

$t - 1 \neq 0$

$t \neq 1$

$Domain = (-\infty, 0) \cup (0, 1) \cup (1, \infty)$

10. $h(x) = \dfrac{x^2}{\sqrt{x - 2}}$

$x - 2 > 0$

$x > 2$

$x > 2$

$Domain = (2, \infty)$

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Unit 1 Functions and Relations Review Guide

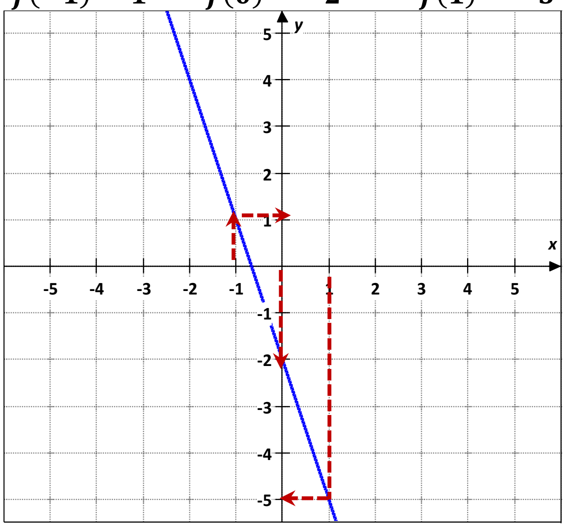
Use a graph of each function to estimate the indicated function values.

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

$f(-1) = ?$ $\quad f(0) = ?$ $\quad f(1) = ?$

Graphically

$f(-1) = 1$ $\quad f(0) = -2$ $\quad f(1) = -5$



Algebraically

$f(-1) = -3 * (-1) - 2 = 3 - 2 = 1$

$f(0) = -3 * 0 - 2 = -2$

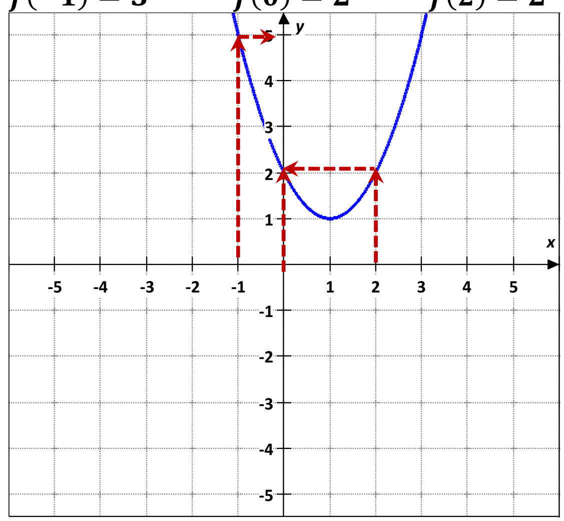
$f(1) = -3 * 1 - 2 = -5$

12. $f(x) = x^2 - 2x + 2$

$f(-1) = ?$ $\quad f(0) = ?$ $\quad f(2) = ?$

Graphically

$f(-1) = 5$ $\quad f(0) = 2$ $\quad f(2) = 2$



Algebraically

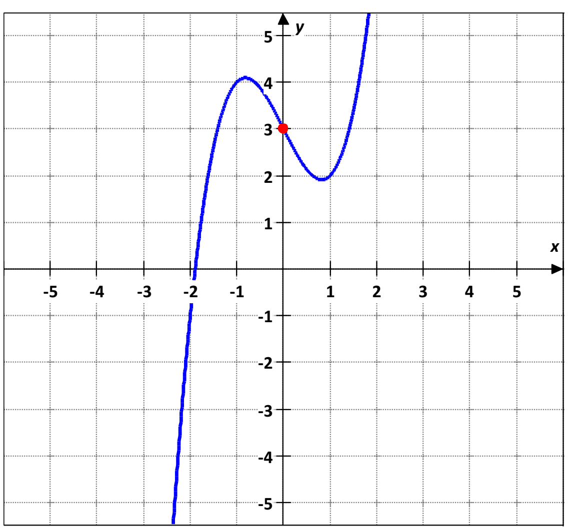
$f(-1) = (-1)^2 - 2 * (-1) + 2 = 1 + 2 + 2 = 5$

$f(0) = 0^2 - 2 * 0 + 2 = 2$

$f(2) = 2^2 - 2 * 2 + 2 = 4 - 4 + 2 = 2$

Use the graph of each function to approximate its y –intercept. Then find the y –intercept algebraically.

13. $f(x) = x^3 - 2x + 3$



Graphically

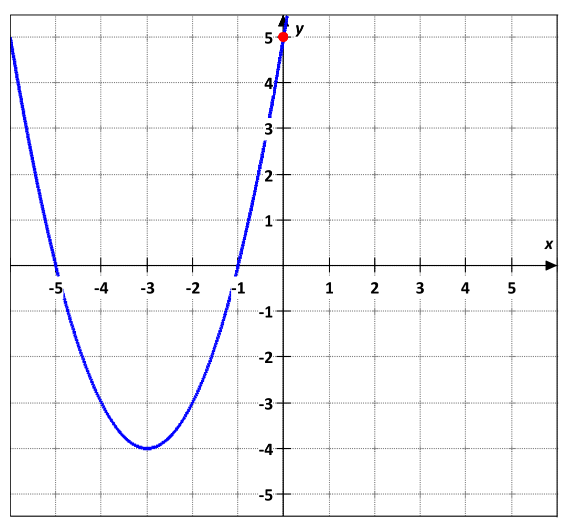
$f(x) = x^3 - 2x + 3$ $\quad$ $y - \text{intercept} = 3$

Algebraically y -intercept occurs where $x = 0$.

$f(0) = 0^3 - 2 * 0 + 3$

$f(0) = 3$ $\quad$ $y - \text{intercept} = 3$

14. $f(x) = (x + 3)^2 - 4$



Graphically

$f(x) = (x + 3)^2 - 4$ $\quad$ $y - \text{intercept} = 5$

Algebraically y -intercept occurs where $x = 0$.

$f(0) = (0 + 3)^2 - 4$

$f(0) = 5$ $\quad$ $y - \text{intercept} = 5$

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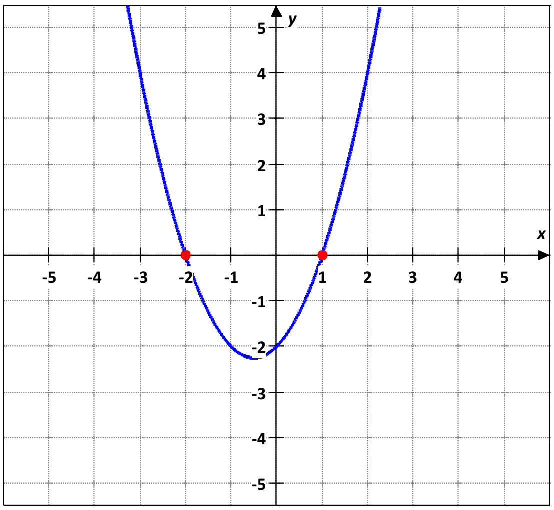
Unit 1 Functions and Relations Review Guide

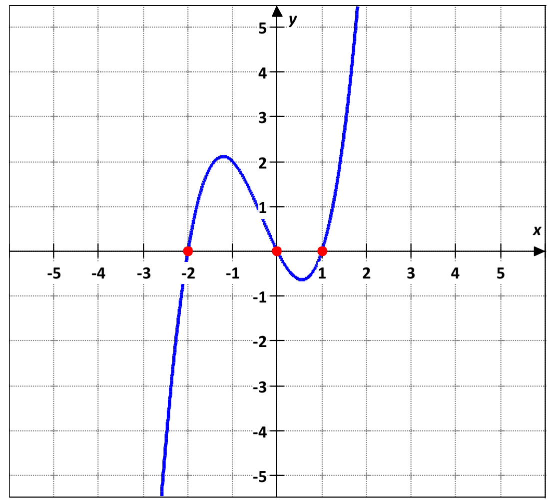
Use the graph of each function to approximate its zeros. Then find the zeros of each function algebraically.

15. $f(x) = x^2 + x - 2$



Graphically
x − intercepts -2 *and* 1
Algebraically
$f(x) = 0$
$x^2 + x - 2 = 0$
$(x+2)(x-1) = 0$
$x = -2$ *and* $x = 1$
The zeros of f are -2 *and* 1

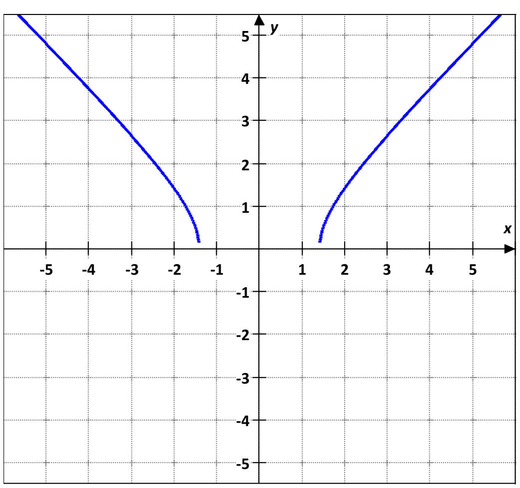
16. $f(x) = x^3 + x^2 - 2x$



Graphically
x − intercepts $-2, 0$ *and* 1
Algebraically
$f(x) = 0$
$x^3 + x^2 - 2x = 0$
$x(x+2)(x-1) = 0$
$x = 0$ $x = -2$ *and* $x = 1$
The zeros of f are $0, -2$ *and* 1

Use the graph of function to test for symmetry with respect to the x -axis, y -axis, and the origin. Support the answer numerically. Then confirm algebraically.

17. $y = \sqrt{x^2 - 2}$



<u>Graphically</u> The graph appears to be symmetric with respect to the y –axis because for every point (x, y) on the graph, there is a point $(-x, y)$.

<u>Support Numerically</u> There is a table of values to support this conjecture.

x	-3	-2	2	3
y	$\sqrt{7}$	$\sqrt{2}$	$\sqrt{2}$	$\sqrt{7}$
(x,y)	$(-3,\sqrt{7})$	$(-2,\sqrt{2})$	$(2,\sqrt{2})$	$(-3,\sqrt{7})$

<u>Algebraically</u> Because $y = \sqrt{(-x)^2 - 2}$ is equivalent to $\sqrt{x^2 - 2}$, the graph is symmetric with respect to the y –axis.

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Unit 1 Functions and Relations Review Guide

Determine whether the following are even, odd, or neither.

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

$f(-x) = (-x)^3 + (-x)^2$
$f(-x) = -x^3 + x^2$
$f(-x) = -(x^3 - x^2)$
$f(-x) = -f(x)$ The function is odd.

19. $h(x) = 2x^4 - x^3 - 3x + 2$

$h(-x) = 2(-x)^4 - (-x)^3 - 3(-x) + 2$
$h(-x) = 2x^4 + x^3 + 3x + 2$
$h(-x) \neq h(x)$ $h(-x) \neq -h(x)$
The function is neither

20. $g(x) = x^4 - 7x^2$

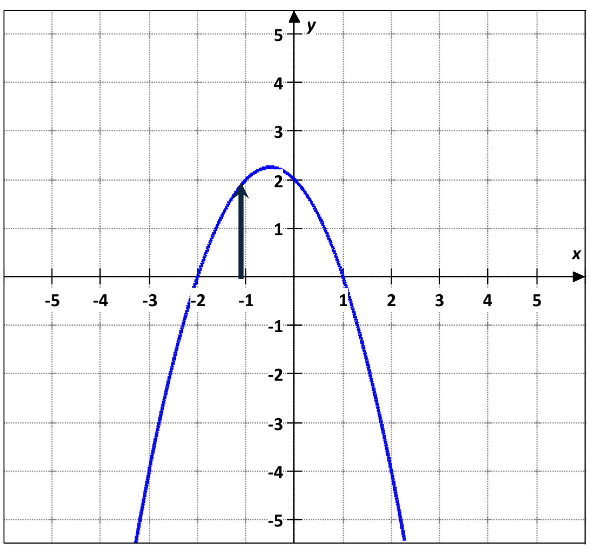
$g(-x) = (-x)^4 - 7(-x)^2$
$g(-x) = x^4 - 7x^2$
$g(-x) = g(x)$ The function is even.

21. $h(x) = \dfrac{1}{x^2 - 7}$

$h(-x) = \dfrac{1}{(-x)^2 - 7}$
$h(x) = \dfrac{1}{x^2 - 7}$
$h(-x) = h(x)$ The function is even.

Determine whether the function is continuous at the given x -value. Justify using the continuity test.

22. $f(x) = -x^2 - x + 2$ *at* $x = -1$



$f(x) = -x^2 - x + 2$ *at* $x = -1$
$f(-1) = -(-1)^2 - (-1) + 2$
$f(-1) = -1 + 1 + 2 = 2$
$f(-1)$ *exists*
$x \to -1^-$ $y \to 2$

x	-1.1	-1.01	-1.001
$f(x)$	1.89	1.989	1.998

$x \to -1^+$ $y \to 2$

x	-0.999	-0.99	-0.9
$f(x)$	2.000	2.009	2.09

$f(-1) = 2$ *and* $y \to 2$ *from both side of* $x = -1$
$\lim_{x \to -1} -x^2 - x + 2 = f(-1)$
$f(x) = -x^2 - x + 2$ *is continuous at* $x = -1$

Find the value of k so that $f(x)$ is continuous.

23. $f(x) = \begin{cases} 2kx - 6 & if\ x > 2 \\ x + 3k & if\ x \leq 2 \end{cases}$

$2kx - 6 = x + 3k$ $x = 2$

$2k * 2 - 6 = 2 + 3k$
$4k - 3k = 2 + 6$
$k = 8$

24. $f(x) = \begin{cases} 5kx + 1 & if\ x > 5 \\ 3x - 2k & if\ x \leq 5 \end{cases}$

$5kx + 1 = 3x - 2k$ $x = 5$
$5k * 5 + 1 = 3 * 5 - 2k$
$25k + 1 = 15 - 2k$
$25k + 2k = 15 - 1$
$27k = 14$
$k = \dfrac{14}{27}$

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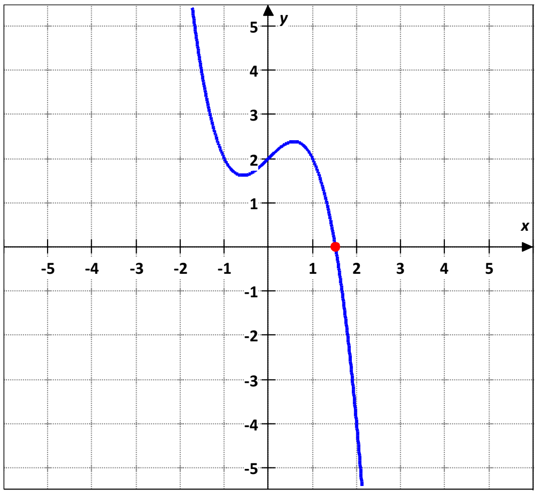
Unit 1 Functions and Relations Review Guide

Determine between which consecutive integers the real zeros of function are located on the given interval.

25. $f(x) = -x^3 + x + 2 \quad [-1, 3]$

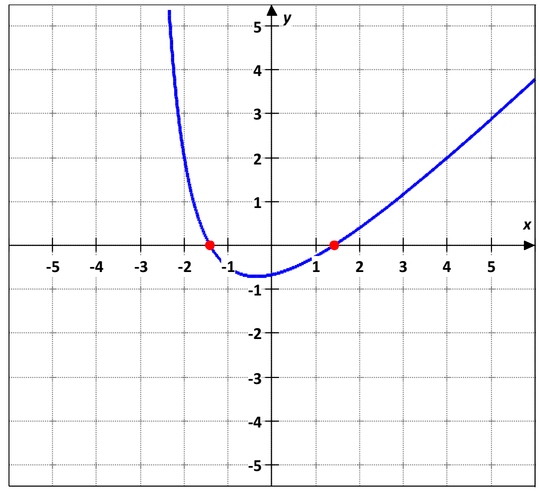


x	-1	0	1	2	3
y	2	2	2	-4	-22

$f(1)$ is positive and $f(2)$ is negative,
$f(x)$ *change sign in* $1 < x < 2$

$f(x)$ has zero in interval: $1 < x < 2$

26. $f(x) = \dfrac{x^2 - 2}{x + 3} \quad [-3, 3]$



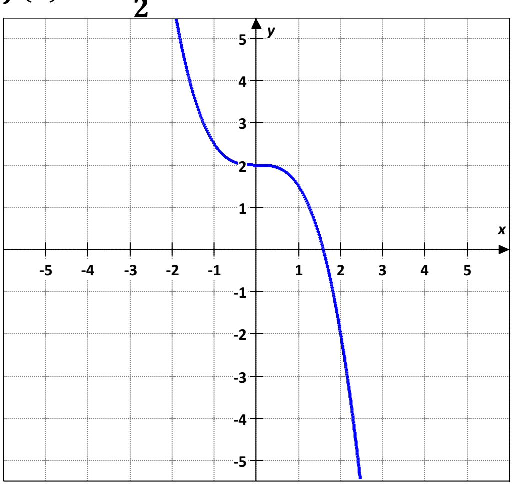
x	-3	-2	-1	0	1	2	3
y	∞	2	$-\frac{1}{2}$	$-\frac{2}{3}$	$-\frac{1}{4}$	$\frac{2}{5}$	$\frac{7}{6}$

$f(-2)$ is positive and $f(-1)$ is negative,
$f(x)$ *change sign in* $-2 < x < -1$
$f(1)$ is negative and $f(2)$ is positive
$f(x)$ *change sign in* $1 < x < 2$

$f(x)$ has zeros in intervals:
$-2 < x < -1$ ***and*** $1 < x < 2$

Use the graph of the function to describe its end behavior. Support the conjecture numerically.

27. $f(x) = -\dfrac{1}{2}x^3 + 2$



From the graph, it appears that:

$f(x) \to \infty$ as $x \to -\infty$ and $f(x) \to -\infty$ as $x \to \infty$

The table supports this conjecture.

x	-10^4	-10^3	0	10^3	10^4
y	$\frac{1}{2} * 10^{12}$	$\frac{1}{2} * 10^{9}$	2	$-\frac{1}{2} * 10^{9}$	$-\frac{1}{2} * 10^{12}$

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Evaluate the following limits.

28. $\lim_{x\to 4} = \dfrac{x^2-16}{x-4} = ?$

$\lim_{x\to 4} = \dfrac{x^2-16}{x-4} = \dfrac{(x-4)(x+4)}{x-4}$

$\lim_{x\to 4} = \dfrac{x^2-16}{x-4} = \lim_{x\to 4}(x+4) = 4+4 = \mathbf{8}$

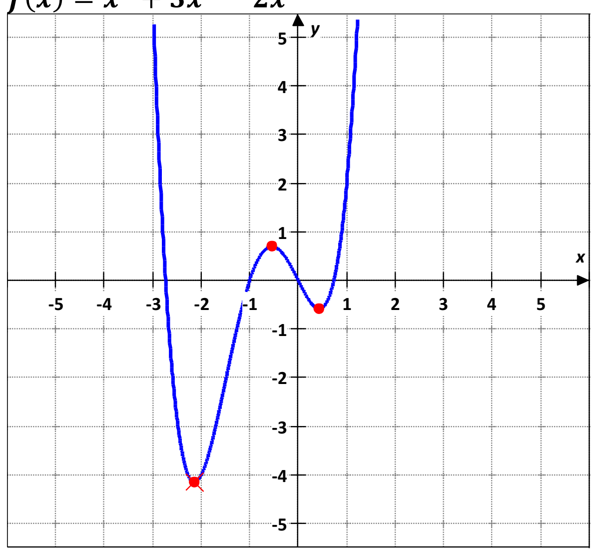
29. $\lim_{x\to -1} x^2+6x-3 = ?$

$\lim_{x\to -1} x^2+6x-3 =$

$\lim_{x\to -1} (-1)^2+6*(-1)-3 = 1-6-3 = \mathbf{-8}$

Estimate and classify the extrema for the graph of the function. Support the answers numerically.

30. $f(x) = x^4+3x^3-2x$



From the graph, it appears that:

$f(x)$ has absolute minimum in $x=-2.14$

$f(x)$ has relative maximum in $x=-0.54$

$f(x)$ has relative minimum in $x=0.43$

$\lim_{x\to -\infty} f(x) = \infty$ and $\lim_{x\to \infty} f(x) = \infty$

$f(x)$ has no absolute maxima.

$x < -2.14$ or $(-\infty; -2.14)$

x	-3.6	-3.36	-3.12	-2.40
y	35	20.38	9.88	-3.50

$-2.14 < x < -0.54$ or $(-2.14; -0.54)$

x	-1.92	-1.2	-0.96	-0.72
	-3.83	-0.71	0.12	0.58

$-0.54 < x < 0.43$ or $(-0.54; 0.43)$

x	-0.24	0	0.24	0.40
	0.44	0	-0.44	-0.58

$x > 0.43$ or $(0.43; \infty)$

x	0.72	1.2	1.44	2.16
y	-0.05	4.8	10.38	47.68

The tables support this conjecture.

For interval $(-\infty; -2.14)$ the function is decreasing.
In $x=-2.14$, $f(x)$ has absolute minimum.
For interval $(-2.14; -0.54)$ the function is increasing.
In $x=-0.54$, $f(x)$ has relative maximum.
For interval $(-0.54; 0.43)$ the function is decreasing.
In $x=0.43$, $f(x)$ has relative minimum.
For interval $(0.43; \infty)$ the function is increasing.

Find the average rate of change of each function on the given interval.

31. $f(x) = 3x+4$ $[1;2]$

$\dfrac{f(x_2)-f(x_1)}{x_2-x_1} = \dfrac{f(2)-f(1)}{2-1} =$

$= \dfrac{3*2+4-(3*1+4)}{1} =$

$= \dfrac{6+4-(3+4)}{1} = 10-7 = \mathbf{3}$

The average rate of change on the interval $[1;2]$ is $\mathbf{3}$.

32. $f(x) = x^2+3$ $[1;0]$

$\dfrac{f(x_2)-f(x_1)}{x_2-x_1} = \dfrac{f(0)-f(1)}{0-1} =$

$= \dfrac{0^2+3-(1^2+3)}{-1} = \dfrac{3-1-3}{-1} = \dfrac{-1}{-1}$

$= \mathbf{1}$

The average rate of change on the interval $[1;0]$ is $\mathbf{1}$

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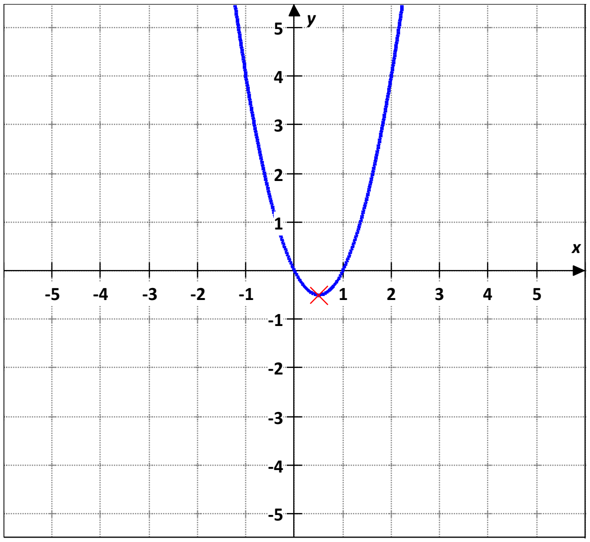
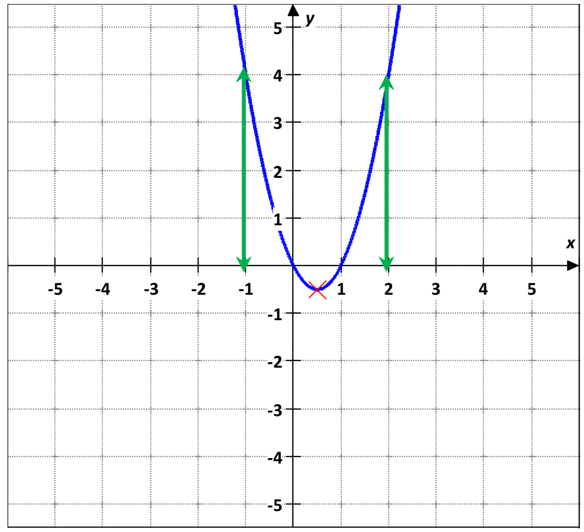
33. $f(x) = 2x^2 - 2x \quad [-1; 2]$





$$\frac{f(x_2) - f(x_1)}{x_2 - x_1} = \frac{f(2) - f(-1)}{2 - (-1)} = \frac{4 - 4}{3} = \frac{0}{3} = \mathbf{0}$$

Identify the parent function and describe the transformations.

34. $f(x) = (x - 1)^2 - 2$

Parent : $f(x) = x^2$
Transformation: Translated 1 unit right
Translated 2 units down

35. $f(x) = -|x - 4|$

Parent : $f(x) = |x|$
Transformation: Reflected in the x-axis
Translated 4 units right

36. $f(x) = \sqrt{x + 3} + 6$

Parent : $f(x) = \sqrt{x}$
Transformation: Translated 3 units left
Translated 6 units up

Use the graph of parent function to graph each function. Find the domain and the range of the new function.

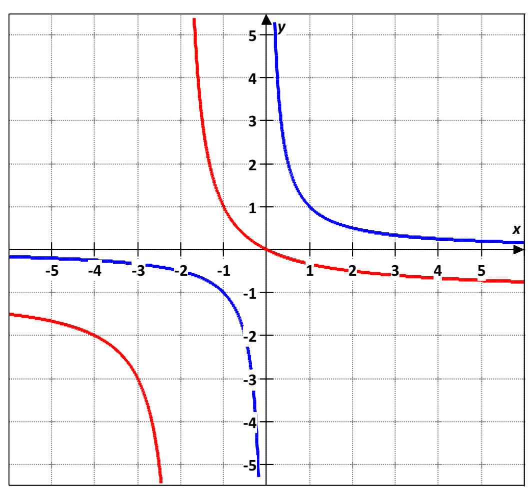
37. $g(x) = \dfrac{3}{x + 2} - 1$

$g(x) = \frac{3}{x+2} - 1$

Parent function $f(x) = \frac{1}{x}$

Transformation:
Translated 2 units left
Translated 1 unit down

$D = (-\infty, -2) \cup (-2, \infty)$
$R = (-\infty, -1) \cup (-1, \infty)$



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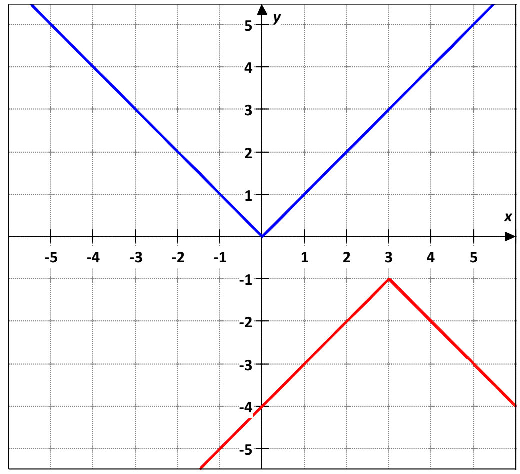
38. $g(x) = -|x-3| - 1$

$g(x) = -|x-3| - 1$ (red arrow)

Parent function $f(x) = |x|$ (blue arrow)



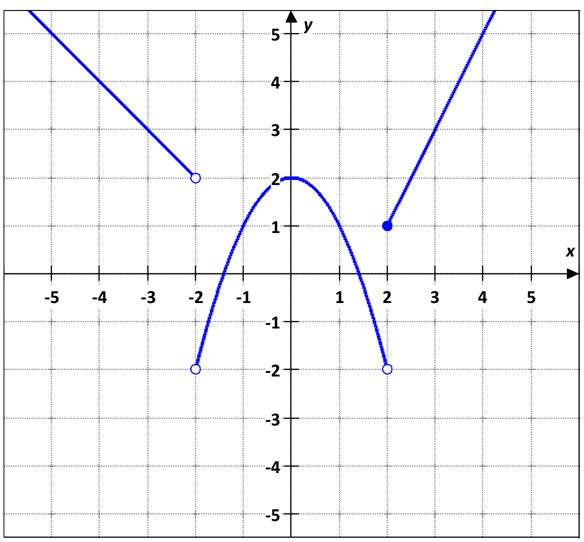
Transformation:
Reflected in the x-axis
Translated 3 units right
Translated 1 unit down

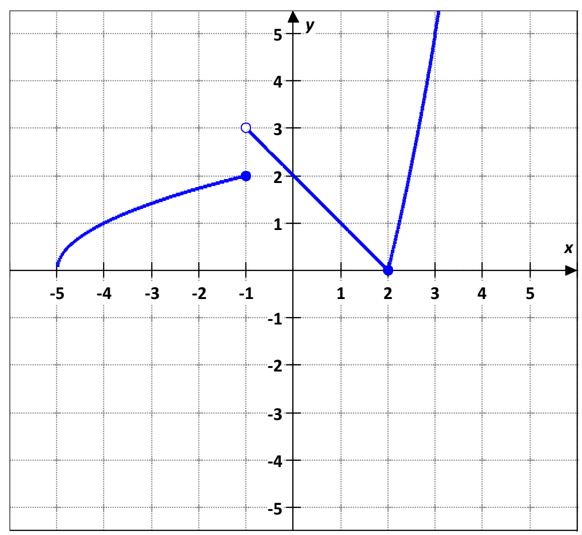
$D = (-\infty, \infty)$
$R = (-\infty, -1]$

Graph each piecewise function.

39. $f(x) = \begin{cases} |x| & \text{if } x < -2 \\ -x^2 + 2 & \text{if } -2 < x < 2 \\ 2x - 3 & \text{if } x \geq 2 \end{cases}$

40. $f(x) = \begin{cases} \sqrt{x+5} & \text{if } x \leq -1 \\ -x + 2 & \text{if } -1 < x < 2 \\ x^2 - 4 & \text{if } x \geq 2 \end{cases}$





Find $(f+g)(x), (f-g)(x), (f*g)(x), and\ \left(\frac{f}{g}\right)(x)$ for each $f(x)$ and $g(x)$. Determine the domain of each new function.

41. $f(x) = 2x + 6 \qquad g(x) = x - 1$

$(f+g)(x) = (2x+6) + (x-1)$
$(f+g)(x) = 3x + 5$
$D_{f+g} = (-\infty, \infty)$
$(f-g)(x) = (2x+6) - (x-1)$
$(f-g)(x) = 2x + 6 - x + 1$
$(f-g)(x) = x + 7$
$D_{f-g} = (-\infty, \infty)$

$(f*g)(x) = (2x+6)*(x-1)$
$(f*g)(x) = 2x^2 + 4x - 6$
$D_{f*g} = (-\infty, \infty)$
$\left(\frac{f}{g}\right)(x) = \frac{2x+6}{x-1}$
$D_{\frac{f}{g}} = (-\infty, 1) \cup (1, \infty)$

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42. $f(x) = 2x^3 \qquad g(x) = x^2 - 1$

$(f+g)(x) = (2x^3) + (x^2 - 1)$
$(f+g)(x) = 2x^3 + x^2 - 1$
$D_{f+g} = (-\infty, \infty)$
$(f-g)(x) = (2x^3) - (x^2 - 1)$
$(f-g)(x) = 2x^3 - x^2 + 1$
$D_{f-g} = (-\infty, \infty)$

$(f*g)(x) = (2x^3) * (x^2 - 1)$
$(f*g)(x) = 2x^5 - 2x^3$
$D_{f*g} = (-\infty, \infty)$
$\left(\frac{f}{g}\right)(x) = \frac{2x^3}{x^2 - 1}$
$x^2 - 1 \neq 0$
$x^2 \neq 1$
$x \neq \pm 1$
$D_{\frac{f}{g}} = (-\infty, -1) \cup (-1, 1) \cup (1, \infty)$

Find each composite function. Determine the domain of each composite function.

43. $f(x) = x^2 - 3 \qquad g(x) = x - 3$
$(f \circ g)(x) = ? \qquad D_{f \circ g} = ?$

$(f \circ g)(x) = f(g(x))$
$f(g(x)) = (g(x))^2 - 3$
$f(g(x)) = (x-3)^2 - 3$
$f(g(x)) = x^2 - 6x + 9 - 3$
$f(g(x)) = x^2 - 6x + 6$

$D_{f \circ g} = (-\infty, \infty)$

44. $f(x) = \sqrt{x+3} \qquad g(x) = x^2 - 1$
$(g \circ f)(x) = ? \qquad D_{g \circ f} = ?$

$(g \circ f)(x) = g(f(x))$
$g(f(x)) = (f(x))^2 - 1$
$g(f(x)) = (\sqrt{x+3})^2 + 3 \qquad x + 3 \geq 0 \qquad x \geq -3$
$g(f(x)) = x + 3 + 3$
$g(f(x)) = x + 6$

$D_f = [-3, \infty)$
$D_{g \circ f} = [-3, \infty)$

Find and then evaluate each composite function.

45. $f(x) = \sqrt{3 - x} \quad g(x) = x^2 + 2$
$(f \circ g)(-1) = ?$

$(f \circ g)(x) = f(g(x))$
$f(g(x)) = \sqrt{3 - g(x)}$
$f(g(x)) = \sqrt{3 - (x^2 + 2)}$
$f(g(x)) = \sqrt{-x^2 + 1}$

$f(g(-1)) = \sqrt{-(-1)^2 + 1}$
$f(g(-1)) = 0$

46. $f(x) = \frac{7}{x} \qquad g(x) = \frac{x}{4}$
$(g \circ f)(7) = ?$
$(g \circ f)(x) = g(f(x))$
$g(f(x)) = \frac{f(x)}{4}$
$g(f(x)) = \frac{\frac{7}{x}}{4}$
$g(f(x)) = \frac{7}{4x}$

$g(f(7)) = \frac{7}{4 * 7}$
$g(f(7)) = \frac{1}{4}$

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Express $h(x)$ as a composition of two functions f and $(f \circ g)(x)$.

47. $h(x) = \sqrt[4]{x^2+4}$

$h(x) = \sqrt[4]{x^2+4}$
$h(x) = (f \circ g)(x) = f(g(x))$
$f(g(x)) = \sqrt[4]{g(x)} = \sqrt[4]{x^2+4}$

$f(x) = \sqrt[4]{x}$
$g(x) = x^2+4$

48. $h(x) = (x-24)^5$

$h(x) = (x-24)^5$
$h(x) = (f \circ g)(x) = f(g(x))$
$f(g(x)) = (g(x))^5 = (x-24)^5$

$f(x) = x^5$
$g(x) = x-24$

Find an equation for the inverse of each of the one to one function.

49. $f(x) = 2x+7$

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

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

$f(x) = 2x^3-3$
$y = 2x^3-3$
$x = 2y^3-3$
$x+3 = 2y^3-3+3$
$x+3 = 2y^3$
$\frac{x+3}{2} = y^3$
$\sqrt[3]{\frac{x+3}{2}} = y$

$f^{-1}(x) = \sqrt[3]{\frac{x-2}{5}}$

Show algebraically that f and g are inverse functions.

51. $f(x) = \frac{x-2}{4}$ $\quad g(x) = 4x+2$

$f(g(x)) = \frac{g(x)-2}{4}$
$f(g(x)) = \frac{4x+2-2}{4}$
$f(g(x)) = \frac{4x}{4}$
$f(g(x)) = x$

$g(f(x)) = 4 * f(x) + 2$
$g(f(x)) = 4 * \frac{x-2}{4} + 2$
$g(f(x)) = x-2+2$
$g(f(x)) = x$

52. $f(x) = \sqrt{x+2}-3$
$g(x) = (x+3)^2-2 \quad x \geq -3$
$f(g(x)) = \sqrt{g(x)+2}-3$
$f(g(x)) = \sqrt{(x+3)^2-2+2}-3$
$f(g(x)) = \sqrt{(x+3)^2}-3$
$f(g(x)) = (x+3)-3$
$f(g(x)) = x$

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