Chapter 7 Absolute Value and Reciprocal Functions

7.1 Absolute Value, pages 363 to 367

1. a) 9 **b)** 0 **c)** 7
d) 4.728 **e)** 6.25 **f)** 5.5

2. $-0.8, -0.4, \left|\frac{3}{5}\right|, |0.8|, 1.1, \left|-1\frac{1}{4}\right|, |-2|$

3. $2.2, \left|-\frac{7}{5}\right|, |1.3|, \left|1\frac{1}{10}\right|, |-0.6|, -1.9, -2.4$

4. **a)** 7 **b)** -5 **c)** 10 **d)** 13

5. Examples:
a) $|2.1 - (-6.7)| = 8.8$ **b)** $|5.8 - (-3.4)| = 9.2$
c) $|2.1 - (-3.4)| = 5.5$ **d)** $|-6.7 - 5.8| = 12.5$

6. **a)** 10 **b)** -2.8 **c)** 5.25 **d)** 9 **e)** 17

7. Examples:
a) $|3 - 8| = 5$ **b)** $|-8 - 12| = 20$
c) $|9 - 2| = 7$ **d)** $|15 - (-7)| = 22$
e) $|a - b|$ **f)** $|m - n|$

8. $|7 - (-11)| + |-9 - 7|$; 34 °C

9. Example:
$|24 - 0| + |24 - 10| + |24 - 17| + |24 - 30| + |24 - 42| + |24 - 55| + |24 - 72|$; 148 km

10. 1743 miles

11. **a)** \$369.37
b) The net change is the change from the beginning point to the end point. The total change is all the changes in between added up.

12. **a)** 7.5 **b)** 90 **c)** 0.875

13. 4900 m or 4.9 km

14. **a)** 1649 ft **b)** 2325 ft

15. \$0.36

16. **a)** 6 km **b)** 9 km

17. **a)** The students get the same result of 90.66.
b) It does not matter the order in which you square something and take the absolute value of it.
c) Yes, because the result of squaring a number is the same whether it was positive or negative.

18. **a)** Michel looks at both cases; the argument is either positive or negative.
b) **i)** $|x - 7| = \begin{cases} x - 7 \text{ if } x \geq 7 \\ 7 - x \text{ if } x < 7 \end{cases}$

ii) $|2x - 1| = \begin{cases} 2x - 1 \text{ if } x \geq \frac{1}{2} \\ 1 - 2x \text{ if } x < \frac{1}{2} \end{cases}$

iii) $|3 - x| = \begin{cases} 3 - x, \text{ if } x \leq 3 \\ x - 3, \text{ if } x > 3 \end{cases}$

iv) $x^2 + 4$

19. Example: Changing +5 to -5 is incorrect.
Example: Change the sign so that it is positive.

20. 83 mm

21. Example: when you want just the speed of something and not the velocity

22. Example: signed because you want positive for up, negative for down, and zero for the top

23. **a)** 176 cm
b) 4; 5; 2; 1; 4; 8; 1; 1; 2; 28 is the sum
c) 3.11
d) It means that most of the players are within 3.11 cm of the mean.

24. **a)** **i)** $x = 1$, $x = -3$
ii) $x = 1$, $x = -5$; you can verify by trying them in the equation.
b) It has no zeros. This method can only be used for functions that have zeros.

25. Example: Squaring a number makes it positive, while the square root returns only the positive root.

7.2 Absolute Value Functions, pages 375 to 379

1. **a)**

x	$y = \|f(x)\|$
-2	3
-1	1
0	1
1	3
2	5

b)

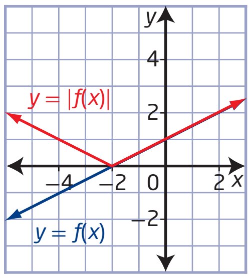
x	$y = \|f(x)\|$
-2	0
-1	2
0	2
1	0
2	4

2. $(-5, 8)$

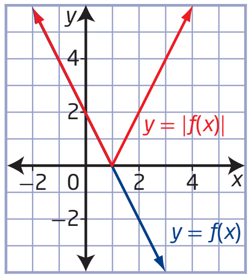
3. x-intercept: 3; y-intercept: 4

4. x-intercepts: -2, 7; y-intercept: $\frac{3}{2}$

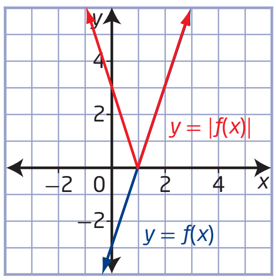
5. **a)**



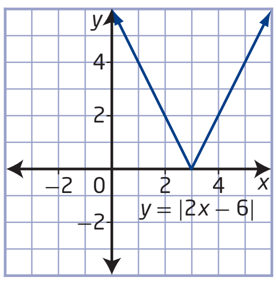
b)



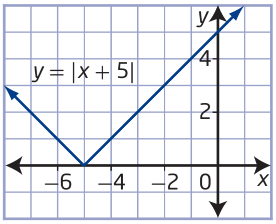
c)



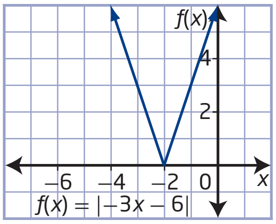
6. **a)** x-intercept: 3; y-intercept: 6;
domain: $\{x \mid x \in \mathrm{R}\}$; range: $\{y \mid y \geq 0, y \in \mathrm{R}\}$



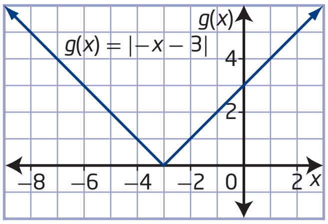
b) x-intercept: -5; y-intercept: 5;
domain: $\{x \mid x \in \mathrm{R}\}$; range: $\{y \mid y \geq 0, y \in \mathrm{R}\}$



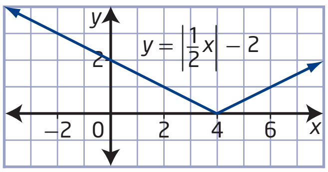
c) x-intercept: -2; y-intercept: 6;
domain: $\{x \mid x \in \mathrm{R}\}$; range: $\{y \mid y \geq 0, y \in \mathrm{R}\}$



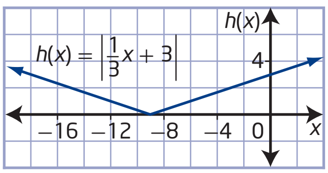
d) x-intercept: -3; y-intercept: 3;
domain: $\{x \mid x \in \mathrm{R}\}$; range: $\{y \mid y \geq 0, y \in \mathrm{R}\}$



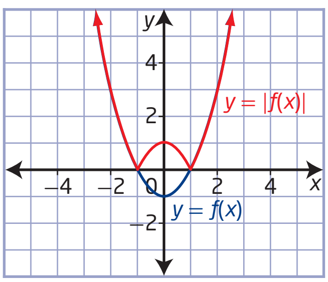
e) x-intercept: 4; y-intercept: 2;
domain: $\{x \mid x \in \mathrm{R}\}$; range: $\{y \mid y \geq 0, y \in \mathrm{R}\}$



f) x-intercept: -9; y-intercept: 3;
domain $\{x \mid x \in \mathrm{R}\}$; range $\{y \mid y \geq 0, y \in \mathrm{R}\}$



7. a)



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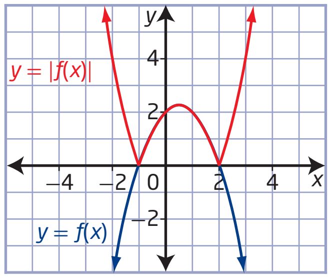
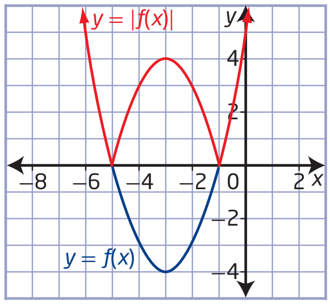
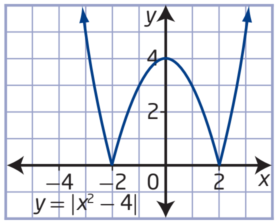


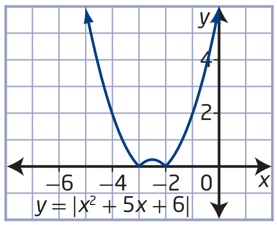
c)



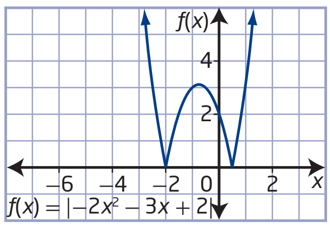
8. a) x-intercepts: -2, 2; y-intercept: 4;
domain: $\{x \mid x \in \mathrm{R}\}$; range: $\{y \mid y \geq 0, y \in \mathrm{R}\}$



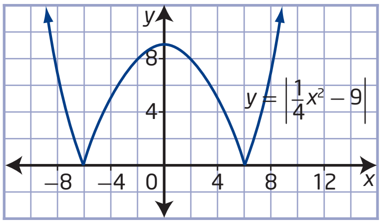
b) x-intercepts: -3, -2; y-intercept: 6;
domain: $\{x \mid x \in \mathrm{R}\}$; range: $\{y \mid y \geq 0, y \in \mathrm{R}\}$



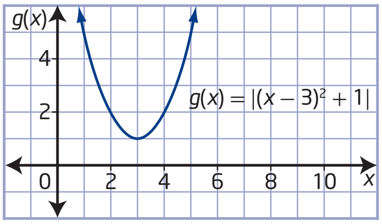
c) x-intercepts: -2, 0.5; y-intercept: 2;
domain: $\{x \mid x \in \mathrm{R}\}$; range: $\{y \mid y \geq 0, y \in \mathrm{R}\}$



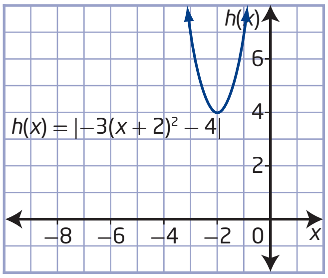
d) x-intercepts: -6, 6; y-intercept: 9; domain: $\{x \mid x \in \mathrm{R}\}$; range: $\{y \mid y \geq 0, y \in \mathrm{R}\}$



e) y-intercept: 10; domain: $\{x \mid x \in \mathrm{R}\}$; range: $\{y \mid y \geq 1, y \in \mathrm{R}\}$



f) y-intercept: 16; domain: $\{x \mid x \in \mathrm{R}\}$; range: $\{y \mid y \geq 4, y \in \mathrm{R}\}$



9. a) $y = 2x - 2$ if $x \geq 1$
$y = 2 - 2x$ if $x < 1$

b) $y = 3x + 6$ if $x \geq -2$
$y = -3x - 6$ if $x < -2$

c) $y = \frac{1}{2}x - 1$ if $x \geq 2$
$y = 1 - \frac{1}{2}x$ if $x < 2$

10. a) $y = 2x^2 - 2$ if $x \leq -1$ or $x \geq 1$
$y = -2x^2 + 2$ if $-1 < x < 1$

b) $y = (x - 1.5)^2 - 0.25$ if $x \leq 1$ or $x \geq 2$
$y = -(x - 1.5)^2 + 0.25$ if $1 < x < 2$

c) $y = 3(x - 2)^2 - 3$ if $x \leq 1$ or $x \geq 3$
$y = -3(x - 2)^2 + 3$ if $1 < x < 3$

11. a) $y = x - 4$ if $x \geq 4$
$y = 4 - x$, if $x < 4$

b) $y = 3x + 5$ if $x \geq -\frac{5}{3}$
$y = -3x - 5$ if $x < -\frac{5}{3}$

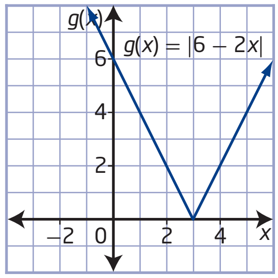
c) $y = -x^2 + 1$ if $-1 \leq x \leq 1$
$y = x^2 - 1$ if $x < -1$ or $x > 1$

d) $y = x^2 - x - 6$ if $x \leq -2$ or $x \geq 3$
$y = -x^2 + x + 6$ if $-2 < x < 3$

12. a)

x	$g(x)$
−1	8
0	6
2	2
3	0
5	4

b)

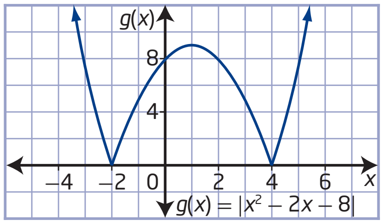


c) domain: $\{x \mid x \in \mathrm{R}\}$; range: $\{y \mid y \geq 0, y \in \mathrm{R}\}$

d) $y = 6 - 2x$ if $x \leq 3$
$y = 2x - 6$ if $x > 3$

13. a) y-intercept: 8; x-intercepts: -2, 4

b)

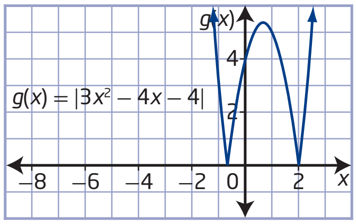


c) domain: $\{x \mid x \in \mathrm{R}\}$; range: $\{y \mid y \geq 0, y \in \mathrm{R}\}$

d) $y = x^2 - 2x - 8$ if $x \leq -2$ or $x \geq 4$;
$y = -x^2 + 2x + 8$ if $-2 < x < 4$

14. a) x-intercepts: $-\frac{2}{3}$, 2; y-intercept: 4

b)

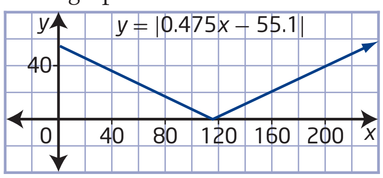


c) domain: $\{x \mid x \in \mathrm{R}\}$; range: $\{y \mid y \geq 0, y \in \mathrm{R}\}$

d) $y = 3x^2 - 4x - 4$ if $x \leq -\frac{2}{3}$ or $x \geq 2$;
$y = -3x^2 + 4x + 4$ if $-\frac{2}{3} < x < 2$

15. Michael is right. Since the vertex of the original function is below the x-axis, the absolute value function will have a different range and a different graph.

16. a)

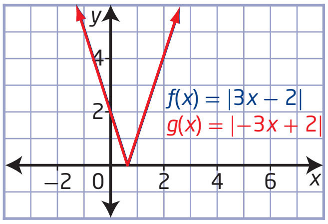


b) (116, 0)

c) (236, 57) is where the puck will be at the far side of the table, which is right in the middle of the goal.

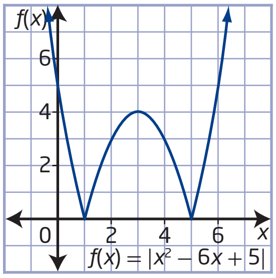
17. The distance travelled is 13 m.

18. a) The two graphs are identical. They are identical because one is the negative of the other but since they are in absolute value brackets there is no change.



b) $f(x) = |-4x - 3|$

19. $f(x) = |-x^2 + 6x - 5|$



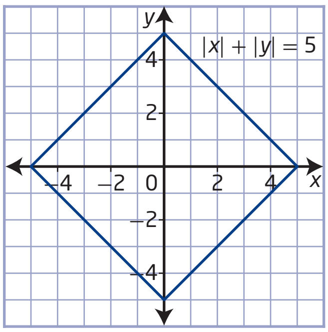
20. $a = -4$, $b = 6$ or $a = 4$, $b = -6$

21. $b = 4$; $c = -12$

22. Example: The square of something is always positive, so taking the absolute value does nothing.

23. Example: No, it is not true for all $x, y \in \mathrm{R}$. For instance, if x and y are of different sign the left side will not equal the right side.

24.



25.

Case	$\lvert x\rvert\lvert y\rvert$	$\lvert xy\rvert$
$x \geq 0, y \geq 0$	xy	xy
$x \geq 0, y < 0$	$x(-y)$	$-xy$
$x < 0, y \geq 0$	$(-x)y$	$-xy$
$x < 0, y < 0$	$(-x)(-y)$	xy

26. Example: They have the same shape but different positions.

27. Example: Graph the functions, taking care to allow them only in their specified domain.

28. If the discriminant is less than or equal to 0 and $a > 0$, then the graphs will be equivalent.

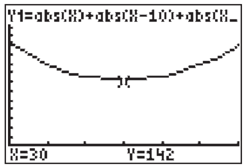
29. Examples:

Step 1 Yes.

Step 2 Absolute value is needed because the facility could be to the east or west of each town.

total $= |x| + |x - 10| + |x - 17| + |x - 30| + |x - 42| + |x - 55| + |x - 72|$

Step 3 x: [0, 60, 10]
y: [−30, 300, 20]



Step 4 The point (30, 142) on the graph shows that there is a point that minimizes the distance to each city. The point represents a place 30 km east of Allenby and results in a total distance from all towns of 142 km.

30. a) $y = |(x - 3)^2 + 7|$ b) $y = \left|\frac{4}{5}(x + 3)^2\right|$
c) $y = |-x^2 - 6|$ d) $y = |5(x + 3)^2 + 3|$

7.3 Absolute Value Equations, pages 389 to 391

1. a) $x = -7, x = 7$ b) $x = -4, x = 4$
c) $x = 0$ d) no solution

2. a) $x = -6, x = 14$ b) $x = -5, x = -1$
c) $x = -14, x = -2$ d) no solution

3. a) $|x| = 2$ b) $|x - 2| = 6$
c) $|x - 4| = 5$

4. a) $x = -19, x = 5$ b) $x = \frac{2}{3}, x = 2$
c) no solution d) $x = 3.5, x = 10.5$

5. a) no solution b) $x = -9, x = 1$
c) $m = -\frac{1}{3}, m = 3$ d) no solution
e) $a = -\frac{11}{3}, a = -3$

6. a) $x = -3, x = \sqrt{3}$ b) $x = 2, x = 3$
c) $x \leq -3$ or $x \geq 3$
d) $x = \frac{1 + \sqrt{5}}{2}, x = \frac{\sqrt{5} - 1}{2}$
e) $x = -4, x = -2, x = 4, x = 6$

7. a) $|d - 18| = 0.5$
b) 17.5 mm and 18.5 mm are allowed

8. a) $|c - 299\,792\,456.2| = 1.1$
b) 299 792 455.1 m/s or 299 792 457.3 m/s

9. a) $|V - 50\,000| = 2000$ b) 48 000 L, 52 000 L

10. a) 2.2, 11.8 b) $|x - 7| = 4.8$

11. a) 66.5 g b) 251 mL and 265 mL

12. a) perigee: 356 400 km; apogee: 406 700 km
b) Example: The moon is usually around 381 550 km away plus or minus 25 150 km.

13. a) greater than or equal to zero
b) less than or equal to zero

14. a) $x = \frac{b + c}{a}$ if $x \geq 0$, $x = \frac{-b - c}{a}$ if $x < 0$; $b + c \geq 0, a \neq 0$
b) $x = b + c$ if $x \geq b$, $x = b - c$ if $x < b$; $c \geq 0$

15. Andrea is correct. Erin did not choose the two cases correctly.

16. $|t - 11.5| = 2.5$; $t = 9$ °C, $t = 14$ °C

17. a) $|x - 81| = 16.2$; 64.8 mg, 97.2 mg

b) Example: They might lean toward 97.2 mg because it would provide more relief because there is more of the active ingredient.

18. $|t - 10| = 2$

19. a) sometimes true; $x \neq -1$

b) sometimes true; if $x = -a$, then the solution is 0. For all other values of x, the solution is greater than 0.

c) always true

20. Examples:

a) $|x - 3| = 5$ **b)** $|x| = -2$

c) $|x| = 0$ **d)** $|x| = 5$

21. Yes; the positive case is $ax + b = 0$, which always has a solution.

22. a) $|x - 3| = 4$ **b)** $|x^2 - 4| = 5$

23. Example: The first equation has no solution because an absolute value expression cannot equal a negative number. The second equation has two solutions because the absolute value expression equates to a positive number, so two cases are possible.

24. Example: When solving each case, the solutions generated are for the domain $\{x \mid x \in R\}$. However, since each case is only valid for a specific domain, solutions outside of that domain are extraneous.

7.4 Reciprocal Functions, pages 403 to 409

1. a) $y = \frac{1}{2 - x}$ **b)** $y = \frac{1}{3x - 5}$

c) $y = \frac{1}{x^2 - 9}$ **d)** $y = \frac{1}{x^2 - 7x + 10}$

2. a) i) $x = -5$ **ii)** $y = \frac{1}{x + 5}$ **iii)** $x \neq -5$

iv) The zeros of the original function are the non-permissible values of the reciprocal function.

v) $x = -5$

b) i) $x = -\frac{1}{2}$ **ii)** $y = \frac{1}{2x + 1}$ **iii)** $x \neq -\frac{1}{2}$

iv) The zeros of the original function are the non-permissible values of the reciprocal function.

v) $x = -\frac{1}{2}$

c) i) $x = -4, x = 4$ **ii)** $y = \frac{1}{x^2 - 16}$

iii) $x \neq -4, x \neq 4$

iv) The zeros of the original function are the non-permissible values of the reciprocal function.

v) $x = -4, x = 4$

d) i) $x = 3, x = -4$ **ii)** $y = \frac{1}{x^2 + x - 12}$

iii) $x \neq 3, x \neq -4$

iv) The zeros of the original function are the non-permissible values of the reciprocal function.

v) $x = 3, x = -4$

3. a) $x = 2$ **b)** $x = -\frac{7}{3}$

c) $x = 2, x = -4$ **d)** $x = 4, x = 5$

4. When $x = 3$, there is a division by zero, which is undefined.

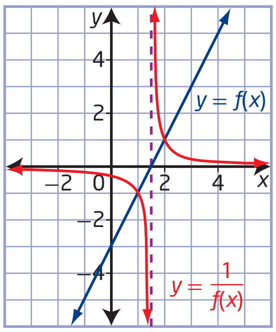
5. a) no x-intercepts, y-intercept: $\frac{1}{5}$

b) no x-intercepts, y-intercept: $-\frac{1}{4}$

c) no x-intercepts, y-intercept: $-\frac{1}{9}$

d) no x-intercepts, y-intercept: $\frac{1}{12}$

6. Example: Locate zeros and invariant points. Use these points to help sketch the graph of the reciprocal function.

a)


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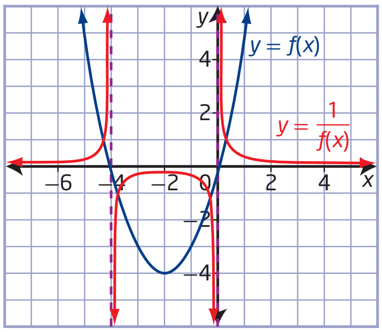

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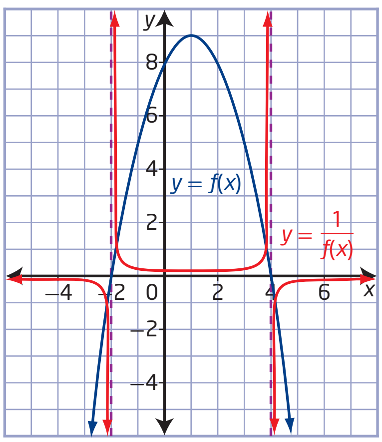
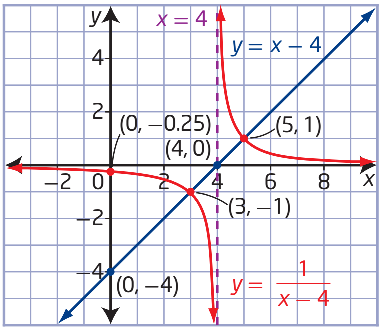
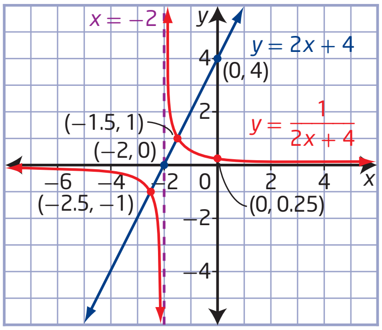


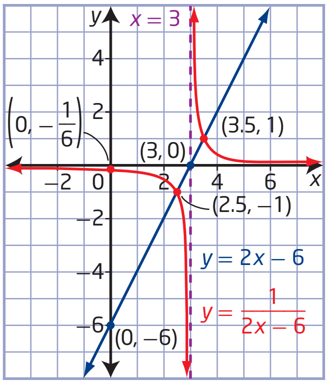
7. a)



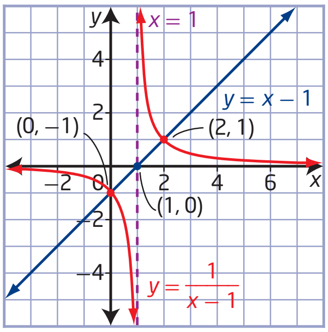
b)



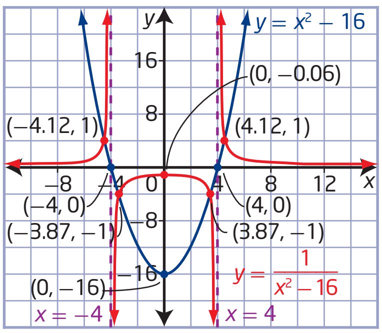
c)



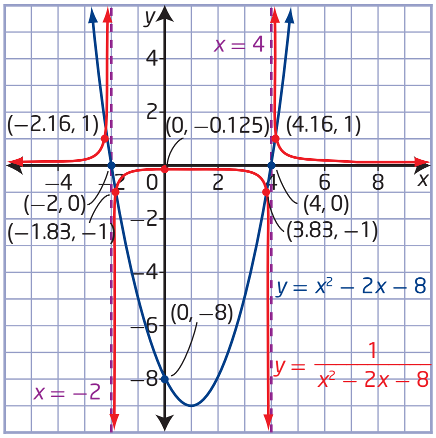
d)



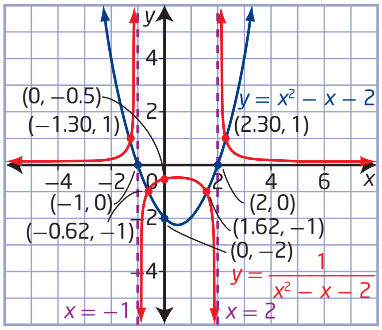
8. a)



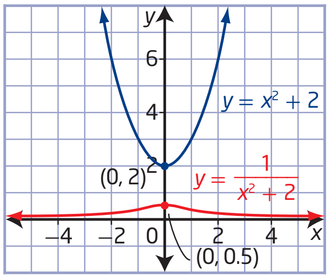
b)



c)

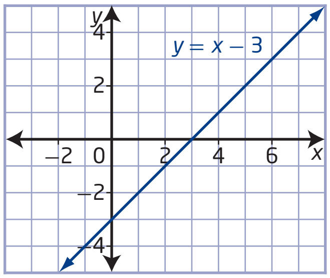


d)



9. a) D **b)** C **c)** A **d)** B

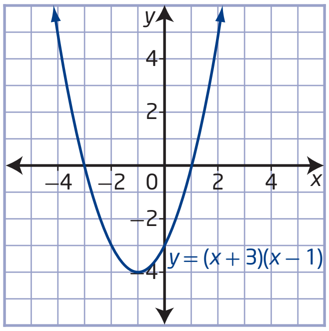
10. a) i)



ii) Example: Use the vertical asymptote to find the zero of the function. Then, use the invariant point and the x-intercept to graph the function.

iii) $y = x - 3$

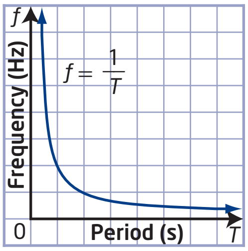
b) i)



ii) Example: Use the vertical asymptotes to find the zeros of the function. Then, use the given point to determine the vertex and then graph the function.

iii) $y = (x + 3)(x - 1)$

11. a)

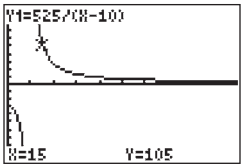


b) $y = T$

c) 0.4 Hz

d) 0.625 s

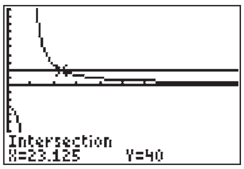
12. a)



b) $\{d \mid d > 10, d \in \mathrm{R}\}$

c) 17.5 min

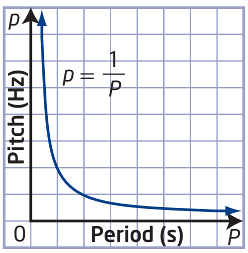
d) 23.125 m; it means that the diver has a maximum of 40 min at a depth of 23.125 m.



e) Yes; at large depths it is almost impossible to not stop for decompression.

13. a) $p = \frac{1}{P}$

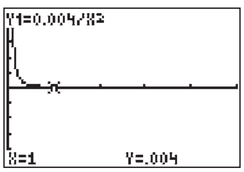
b)



c) 20.8 Hz

14. a) $I = 0.004\frac{1}{d^2}$

b)

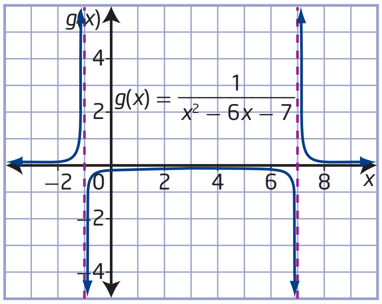


c) 0.000 16 W/m²

15. a) Example: Complete the square to change it to vertex form.

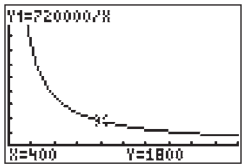
b) Example: The vertex helps with the location of the maximum for the U-shaped section of the graph of $g(x)$.

c)



16. a) $k = 720\ 000$

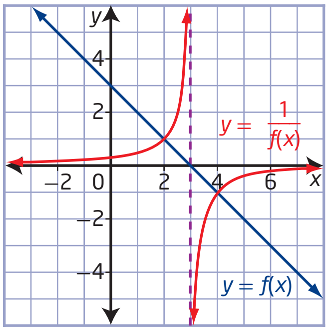
b)



c) 1800 days

d) 1440 workers

17.



18. a) False; only if the function has a zero is this true.

b) False; only if the function has a zero is this true.

c) False; sometimes there is an undefined value.

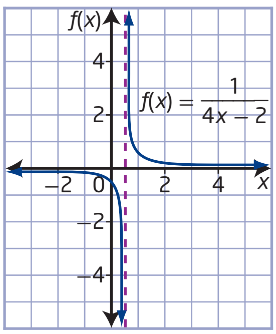
19. a) Both students are correct. The non-permissible values are the roots of the corresponding equation.

b) Yes

20. a) $v = 60$ mm

b) $f = 205.68$ mm

21. Step 1



Step 2

a)

x	$f(x)$
0	−0.5
0.4	−2.5
0.45	−5
0.47	−8.33
0.49	−25
0.495	−50
0.499	−250

x	$f(x)$
1	0.5
0.6	2.5
0.55	5
0.53	8.33
0.51	25
0.505	50
0.501	250

b) The function approaches infinity or negative infinity. The function will always approach infinity or negative infinity.

Step 3

a)

x	$f(x)$
−10	$-\frac{1}{42}$
−100	$-\frac{1}{402}$
−1000	$-\frac{1}{4002}$
−10 000	$-\frac{1}{40\,002}$
−100 000	$-\frac{1}{400\,002}$

x	$f(x)$
10	$\frac{1}{38}$
100	$\frac{1}{398}$
1000	$\frac{1}{3998}$
10 000	$\frac{1}{39\,998}$
100 000	$\frac{1}{399\,998}$

b) The function approaches zero.

22.

$y = f(x)$	$y = \frac{1}{f(x)}$
The absolute value of the function gets very large.	The absolute value of the function gets very small.
Function values are positive.	Reciprocal values are positive.
Function values are negative.	Reciprocal values are negative.
The zeros of the function are the x-intercepts of the graph.	The zeros of the function are the vertical asymptotes of the graph.
The value of the function is 1.	The value of the reciprocal function is 1.
The absolute value of the function approaches zero.	The absolute value of the reciprocal approaches infinity or negative infinity.
The value of the function is −1.	The value of the reciprocal function is −1.

Chapter 7 Review, pages 410 to 412

1. a) 5 **b)** 2.75 **c)** 6.7

2. $-4, -2.7, \left|1\frac{1}{2}\right|, |-1.6|, \sqrt{9}, |-3.5|, \left|-\frac{9}{2}\right|$

3. a) 9 **b)** 2 **c)** 18.75 **d)** 20

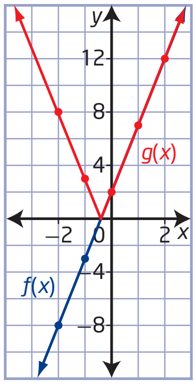
4. 43.8 km

5. a) \$2.12 **b)** \$4.38

6. a)

x	$f(x)$	$g(x)$
−2	−8	8
−1	−3	3
0	2	2
1	7	7
2	12	12

b)



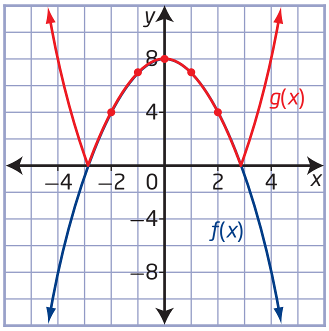
c) $f(x)$: domain $\{x \mid x \in R\}$, range $\{y \mid y \in R\}$; $g(x)$: domain $\{x \mid x \in R\}$, range $\{y \mid y \geq 0, y \in R\}$

d) Example: They are the same graph except the absolute value function never goes below zero; instead it reflects back over the x-axis.

7. a)

x	$f(x)$	$g(x)$
−2	4	4
−1	7	7
0	8	8
1	7	7
2	4	4

b)



c) $f(x)$: domain $\{x \mid x \in R\}$, range $\{y \mid y \leq 8, y \in R\}$; $g(x)$: domain $\{x \mid x \in R\}$, range $\{y \mid y \geq 0, y \in R\}$

d) Example: They are the same graph except the absolute value function never goes below zero; instead it reflects back over the x-axis.

8. a) $y = 2x - 4$ if $x \geq 2$
$y = 4 - 2x$ if $x < 2$

b) $y = x^2 - 1$ if $x \leq -1$ or $x \geq 1$
$y = 1 - x^2$ if $-1 < x < 1$

9. a) The functions have different graphs because the initial graph goes below the *x*-axis. The absolute value brackets reflect anything below the *x*-axis above the *x*-axis.

b) The functions have the same graphs because the initial function is always positive.

10. $a = 15$, $b = 10$

11. a) $x = -3.5$, $x = 5.5$

b) no solution

c) $x = -3$, $x = 3$, $x \approx -1.7$, $x \approx 1.7$

d) $m = -1$, $m = 5$

12. a) $q = -11$, $q = -7$ **b)** $x = \frac{1}{4}$, $x = \frac{2}{3}$

c) $x = 0$, $x = 5$, $x = 7$

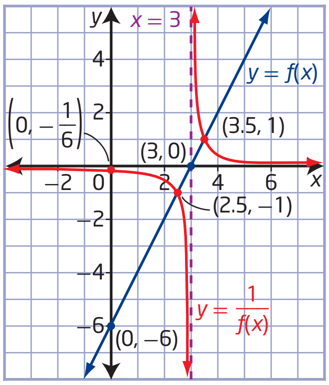
d) $x = \frac{3}{2}$, $x = \frac{-1 + \sqrt{21}}{4}$

13. a) first low tide 2.41 m; first high tide 5.74 m

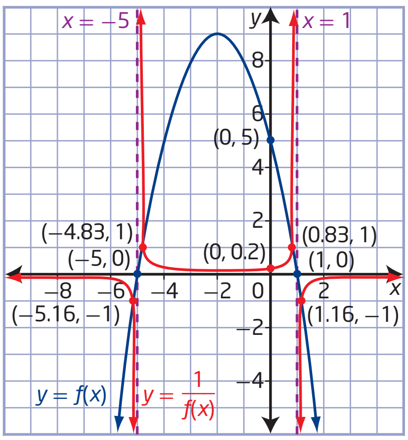
b) The total change is 8.5 m.

14. The two masses are 24.78 kg and 47.084 kg.

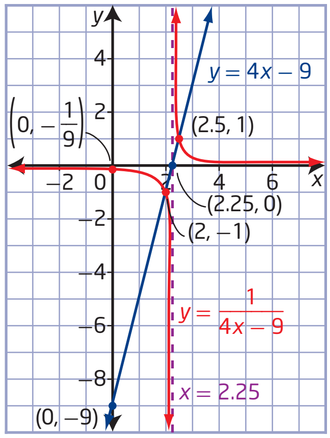
15. a)



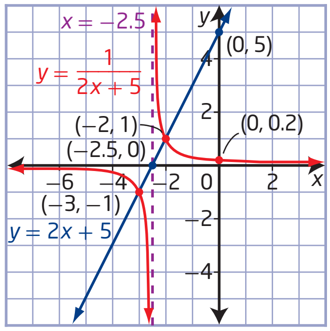
b)



16. a)



b)

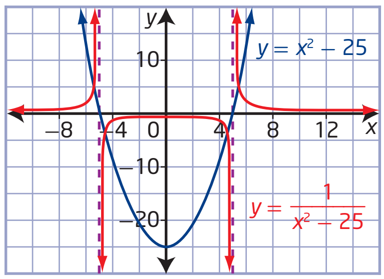


17. a) i) $y = \frac{1}{x^2 - 25}$

ii) The non-permissable values are $x = -5$ and $x = 5$. The equations of the vertical asymptotes are $x = -5$ and $x = 5$.

iii) no *x*-intercepts; *y*-intercept: $-\frac{1}{25}$

iv)

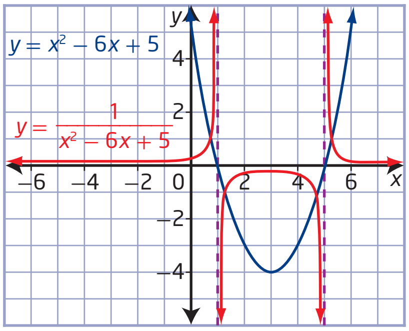


b) i) $y = \frac{1}{x^2 - 6x + 5}$

ii) The non-permissable values are $x = 5$ and $x = 1$. The equations of the vertical asymptotes are $x = 5$ and $x = 1$.

iii) no *x*-intercept; *y*-intercept $\frac{1}{5}$

iv)

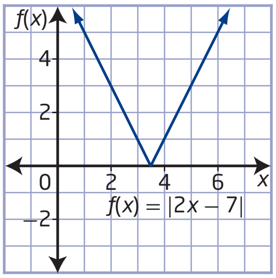


18. a) 240 N **b)** 1.33 m

c) If the distance is doubled the force is halved. If the distance is tripled only a third of the force is needed.

Chapter 7 Practice Test, pages 413 to 414

1. B
2. C
3. D
4. A
5. B
6. a)



b) x-intercept: $\frac{7}{2}$; y-intercept: 7

c) domain: $\{x \mid x \in R\}$; range: $\{y \mid y \geq 0, y \in R\}$

d) $y = 2x - 7$ if $x \geq \frac{7}{2}$

$y = 7 - 2x$ if $x < \frac{7}{2}$

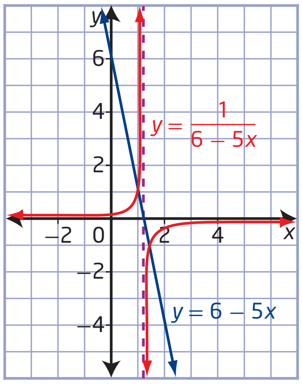
7. $x = 1, x = \frac{2}{3}$

8. $w = 4, w = \frac{2}{3}$

9. Example: In Case 1, the mistake is that after taking the absolute value brackets off, the inside term was incorrectly copied down. It should have been $x - 4$. Then, there are no solutions from Case 1. In Case 2, the mistake is that after taking the absolute value brackets off, the inside term was incorrectly multiplied by negative one. It should have been $-x + 4$. Then, the solutions are $x = \frac{-5 + \sqrt{41}}{2}$ and $x = \frac{-5 - \sqrt{41}}{2}$.

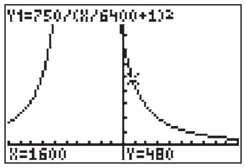
10. a) $y = \frac{1}{6 - 5x}$ **b)** $x = \frac{6}{5}$

c) Example: Use the asymptote already found and the invariant points to sketch the graph.



11. a) $y = |2.5x|$ **b)** 43.6° **c)** 39.3°

12. a)



b) i) 748.13 N **ii)** 435.37 N

c) more than 25 600 km will result in a weight less than 30 N.

Cumulative Review, Chapters 5–7, pages 416 to 417

1. $\sqrt{18x^3y^6}$

2. $4abc^2\sqrt{3ac}$

3. $\sqrt[3]{8}, 2\sqrt{3}, \sqrt{18}, \sqrt{36}, 2\sqrt{9}, 3\sqrt{6}$

4. a) $9\sqrt{2a}, a \geq 0$

b) $11x\sqrt{5}, x \geq 0$

5. a) $-16\sqrt[3]{3}$ **b)** $3\sqrt{2}$

c) $12a - 12\sqrt{a} + 2\sqrt{3a} - 2\sqrt{3}, a \geq 0$

6. a) $\sqrt{3}$ **b)** $4 - 2\sqrt{3}$

c) $-3 - 3\sqrt{2}$

7. $x = 3$

8. a) 430 ft

b) Example: The velocity would decrease with an increasing radius because of the expression $h - 2r$.

9. a) $\frac{a}{4b^3}, a \neq 0, b \neq 0$ **b)** $\frac{-1}{x - 4}, x \neq 4$

c) $\frac{(x - 3)^2(x + 5)}{(x + 2)(x + 1)(x - 1)}, x \neq 1, -1, -2, 3$

d) $\frac{1}{6}, x \neq 0, 2$

e) $1, x \neq -3, -2, 2, 3$

10. a) $\frac{a^2 + 11a - 72}{(a + 2)(a - 7)}$, $a \neq -2, 7$

b) $\frac{3x^3 + x^2 - 11x + 12}{(x + 4)(x - 2)(x + 2)}$, $x \neq -4, -2, 2$

c) $\frac{2x^2 - x - 15}{(x - 5)(x + 5)(x + 1)}$, $x \neq -5, -1, 5$

11. Example: No; they are not equivalent because the expression should have the restriction of $x \neq -5$.

12. $x = 12$

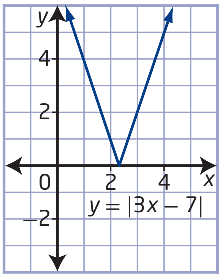
13. $\frac{1}{4}$

14. $|4 - 6|, |-5|, |8.4|, |2(-4) - 5|$

15. a) $y = 3x - 6$ if $x \geq 2$
$y = 6 - 3x$ if $x < 2$

b) $y = \frac{1}{3}(x - 2)^2 - 3$ if $x \leq -1$ or $x \geq 5$
$y = -\frac{1}{3}(x - 2)^2 + 3$ if $-1 < x < 5$

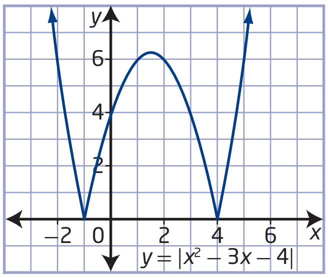
16. a) i)



ii) x-intercept: $\frac{7}{3}$; y-intercept: 7

iii) domain: $\{x \mid x \in R\}$; range: $\{y \mid y \geq 0, y \in R\}$

b) i)



ii) x-intercepts: $-1, 4$; y-intercept: 4

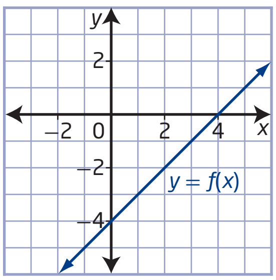
iii) domain: $\{x \mid x \in R\}$; range: $\{y \mid y \geq 0, y \in R\}$

17. a) $x = 5, x = -4$ **b)** $x = 3, x = -3$

18. a) Example: Absolute value must be used because area is always positive.

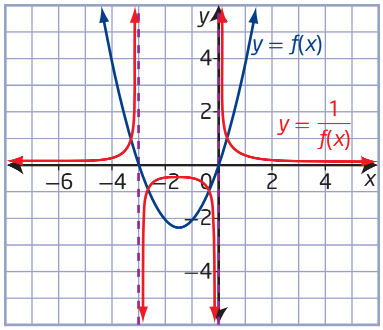
b) Area = 7

19.

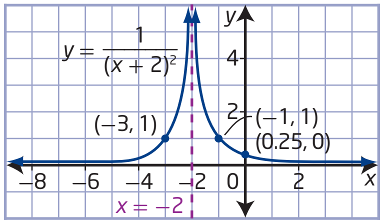


$f(x) = x - 4$

20.



21.



22. a) Example: The shape, range, and y-intercept will be different for $y = |f(x)|$.

b) Example: The graph of the reciprocal function has a horizontal asymptote at $y = 0$ and a vertical asymptote at $x = \frac{1}{3}$.

Unit 3 Test, pages 418 to 419

1. C
2. D
3. B
4. C
5. D
6. B
7. D
8. B
9. 3
10. $\frac{\sqrt{10}}{6}$
11. 28
12. -2
13. $-2, 2$
14. $5, 3\sqrt{7}, 6\sqrt{2}, 4\sqrt{5}$

15. a) Example: Square both sides.

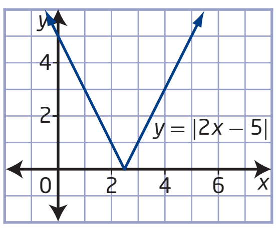
b) $x \geq 2.5$ **c)** There are no solutions.

16. $\frac{4(2x + 5)}{(x - 4)}$, $x \neq -2.5, -2, 1, 0.5, 4$

17. Example:

a) $\frac{2x}{x} = \frac{x + 10}{x + 3}$ **b)** $x \neq -3, 0$ **c)** $x = 4$

18. a)



b) y-intercept: 5; x-intercept: $\frac{5}{2}$

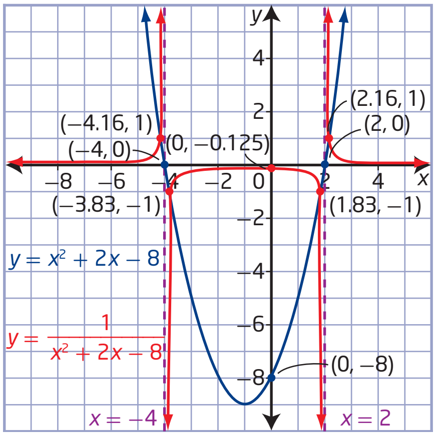
c) domain: $\{x \mid x \in R\}$; range: $\{y \mid y \geq 0, y \in R\}$

d) $y = 2x - 5$ if $x \geq \frac{5}{2}$

$y = 5 - 2x$ if $x < \frac{5}{2}$

19. $x = \frac{3 \pm \sqrt{17}}{2}$, 1, 2

20.



21. a) $t = \frac{72}{s}$ **b)** 4.97 ft/s **c)** 11.43 s