Selected Solutions — Chapter 1

Modelling the Distance to the Horizon, page 8

$d^2 + 6365^2 = (h + 6365)^2$
$d^2 = h^2 + 12\,730h + 6365^2 - 6365^2$
$d = \sqrt{h^2 + 12\,730h}$

- It is assumed that the Earth is a sphere with radius 6365 km.
- $d = \sqrt{h^2 + 12\,730\,000h}$
  $\doteq 3.568\sqrt{h}$

  When h is in metres, it must be divided by 1000 to convert it to kilometres to use the formula.

1.1 Exercises, page 10

4. a) This is the graph of a basic square root function which has been transformed from (0, 0) to $(-3\frac{1}{3}, -2)$.

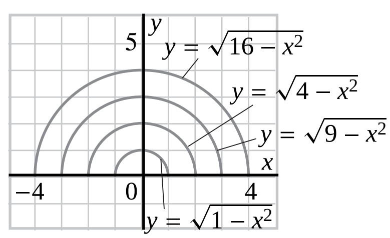
b) This is the graph of a reciprocal function with vertical asymptote $x = 6$ and horizontal $y = 0$.

c) This is the graph of an absolute value function that has been translated down 1 unit.

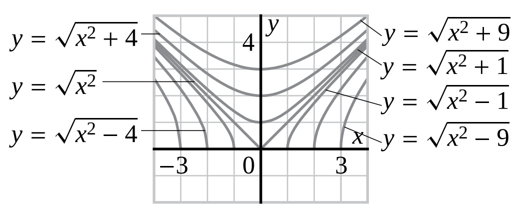
d) This is the graph of a parabola with vertex (–1, –3).

e) This is the graph of a semicircle with centre (2, 0).

5. a)



6. a)



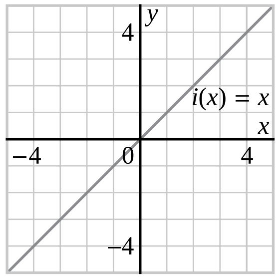
b) For $k > 0$, $y = \sqrt{x^2 + k}$ looks similar to a parabola. As k approaches 0, the graph gets closer to $y = |x|$ from above. For $k < 0$, $y = \sqrt{x^2 + k}$ looks like two half parabolas with the x-axis as axis of symmetry and values only above the x-axis. As k approaches 0, the graph approaches $y = |x|$ from below.

c) For $k = 0$, $y = \sqrt{x^2}$ or $y = |x|$.

d) The function is defined as long as $x^2 + k$ is positive. Thus $k > -x^2$. Since x is all real numbers, k is all real numbers.

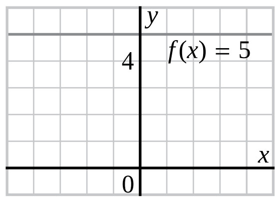
Selected Solutions — Chapter 1

7. b)



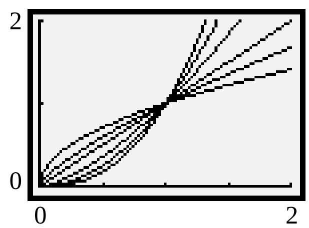
c) The identity or unique value of x is not changed in the function $y = x$.

8. b)



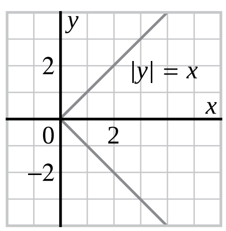
c) The y value remains constant, no matter what the x value is.

9. a)

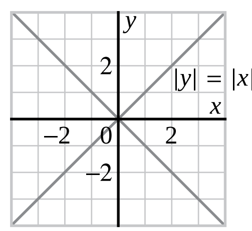


10. Use tables of values to graph the functions.

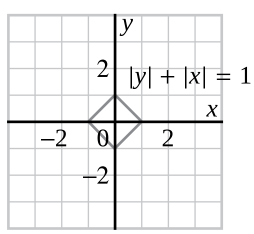
a)



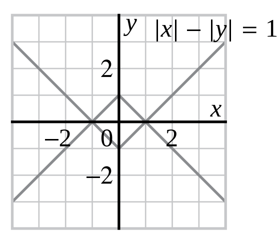
b)



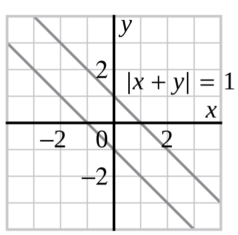
c)



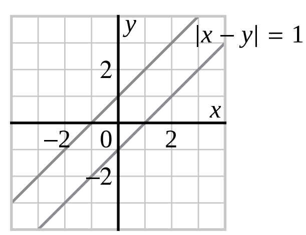
d)



e)



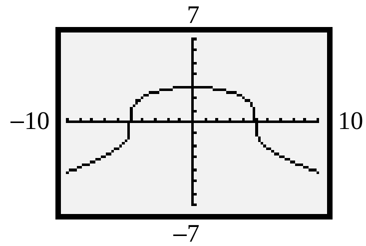
f)



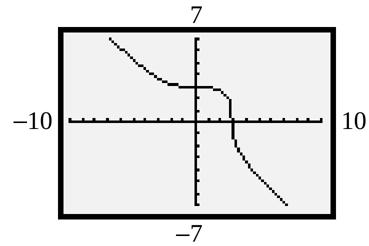
Selected Solutions — Chapter 1

11. Use a graphing calculator.

a)



b)



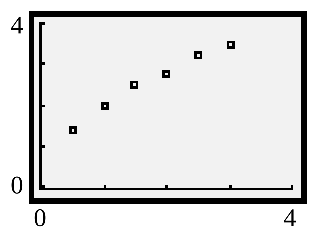
The first graph has x-intercepts –5 and 5. It is symmetric about the y-axis just as the $y = -x^2$ function. Large positive and negative x values produce negative y values. Both graphs have the same y-intercept, $\sqrt[3]{25}$. The second graph has x-intercept $\sqrt[3]{25}$. It is similar to the $y = -x^3$ graph. Large positve x values produce negative y values whereas large negative x values produce large positive y values.

12. The estimated distances will be slightly more than the actual distances for $0 < h < 39$. When $h = 39$ the estimated distance equals the actual distance. When $h > 39$, the extimated distances will be less than the actual distances.

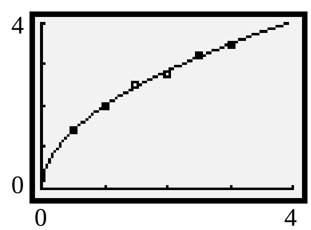
Exploring with a Graphing Calculator, page 15

2. The value of quadratic function gets very large for large values of x. The cubic function returns negative values for large positive values of x. The interest function should approach 0 for large values of x but not intersect or lie below 0.

3. a)



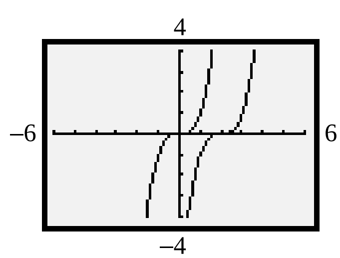
d)



b) The graph is similar to a square root, or $y = \sqrt{x}$. Thus the PwrReg is a suitable choice.

Investigate, page 16

1. c)

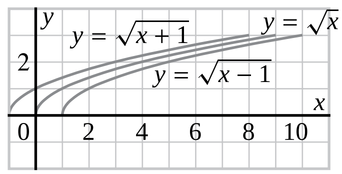


3. Yes. The graphs would all be translated 2 units to the right.

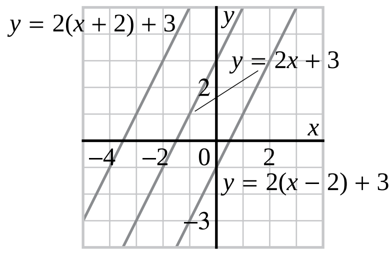
4. c) The value of $y = f(x - k)$ at $x + k$ is the same as the value of $y = f(x)$ at x. Thus, the graph is translated by k units.

Selected Solutions — Chapter 1

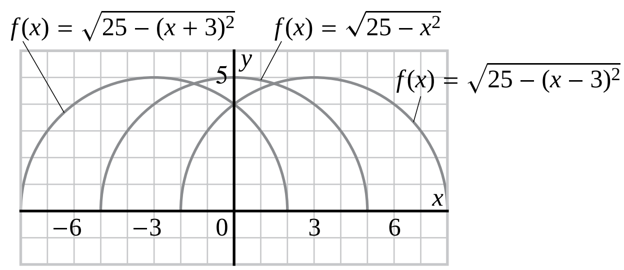
5. a)



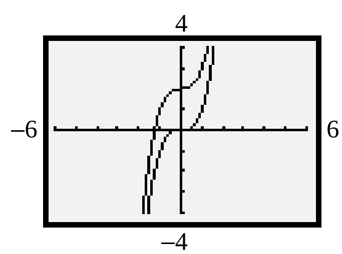
b)



c)



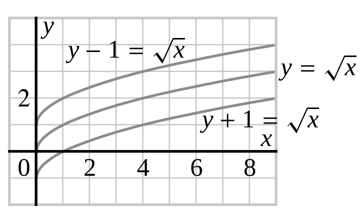
6. c)



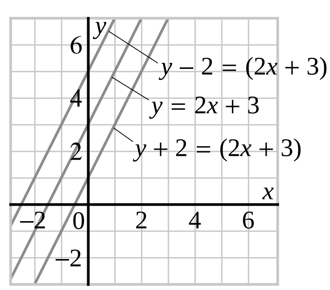
8. Yes. The graphs would all be translated 2 units up.

9. c) The x value of $y - k = f(x)$ at $y + k$ is the same x value as that of $y = f(x)$ at y. Thus, the graph is translated vertically by k units.

10. a)

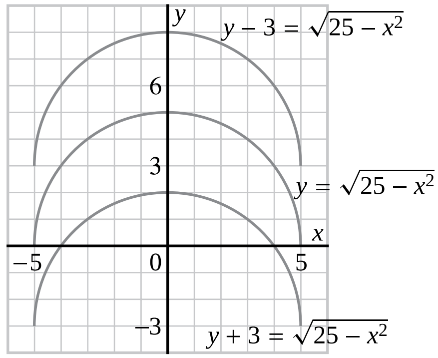


b)



Selected Solutions — Chapter 1

c)



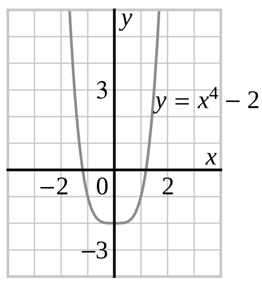
1.2 Exercises, page 21

7. **a)** The graph has vertex (0, 0) and passes through the points (–1, 1) and (1, 1).

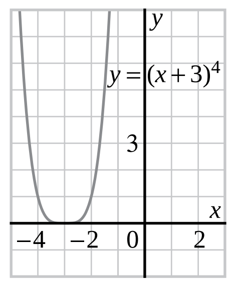
b) The graph has vertex (–1, –3) and passes through the points (–2, –2) and (0, –2).

c) The graph has vertex (3, 1) and passes through the points (2, 2) and (4, 2).

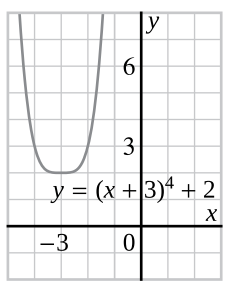
8. **a)**



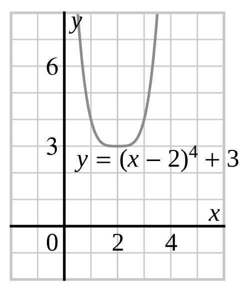
b)



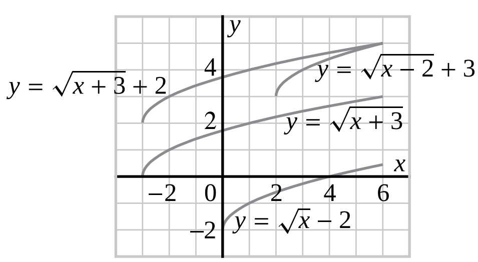
c)



d)



9.



10. Explanations may vary. For exercise 8a:
I translated the graph of $y = x^4$ down 2 units.

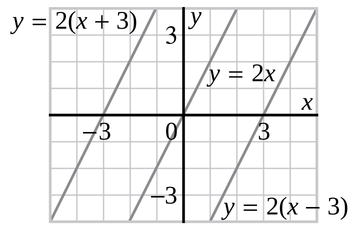
For exercise 8b:
I translated the graph of $y = x^4$ 3 units left.

Selected Solutions — Chapter 1

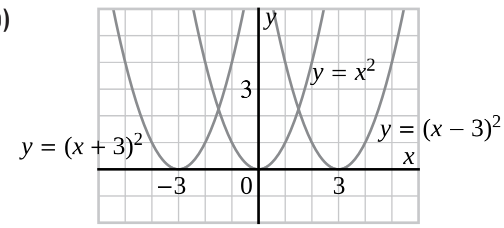
For exercise 8c:
I translated the graph of $y = x^4$ 3 units left and 2 units up.

For exercise 8d:
I translated the graph of $y = x^4$ 2 units right and 3 units up

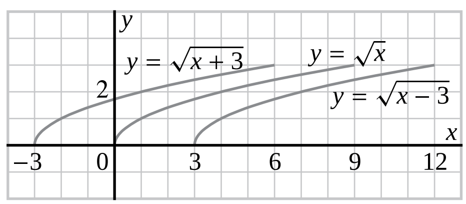
11. a)



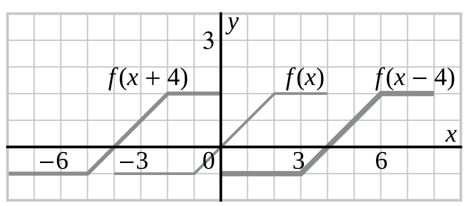
b)



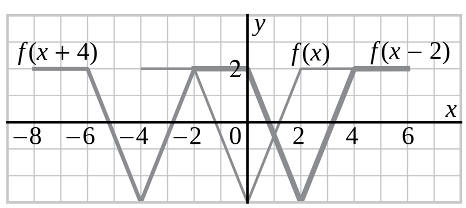
c)



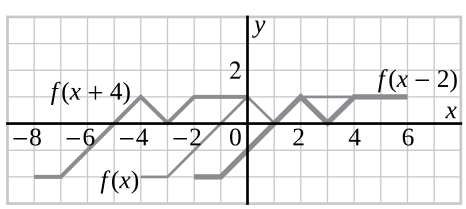
13. a)



b)



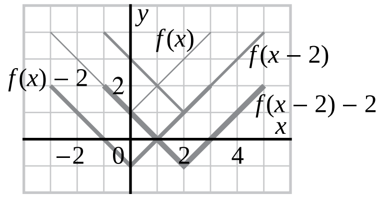
c)



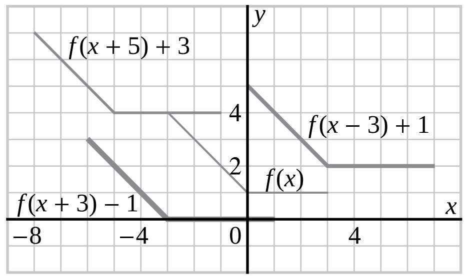
Selected Solutions — Chapter 1

14. Diagrams may vary.

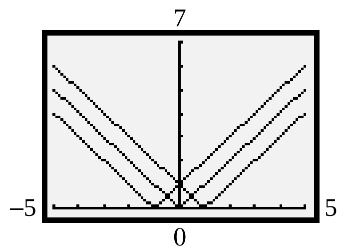
a)



b)

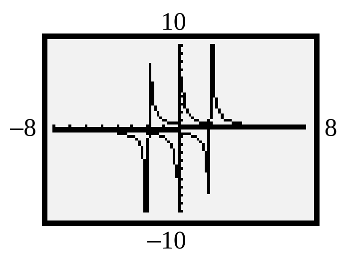


16. a)



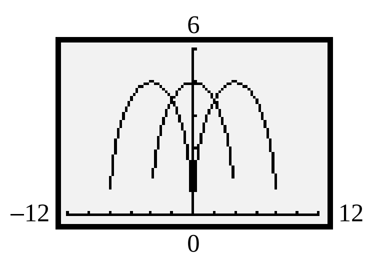
The graph of $y = |x|$ is shifted right and left by 1 unit to obtain the images of $y = |x - 1|$ and $y = |x + 1|$ respectively.

b)



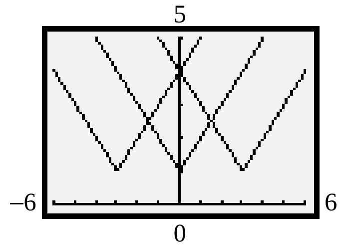
$y = \frac{1}{(x-2)}$ and $y = \frac{1}{(x+2)}$ are images of $y = \frac{1}{x}$ translated 2 units to the right and left respectively.

c)



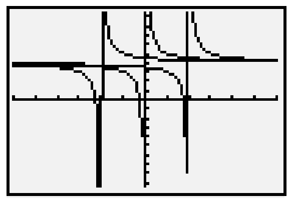
The graphs $y = \sqrt{16 - (x-4)^2}$ and $y = \sqrt{16 - (x+4)^2}$ are images of the graph of $y = \sqrt{16 - x^2}$ translated 4 units right and left respectively.

d)



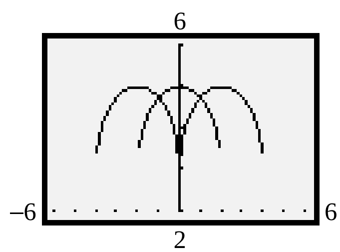
The graphs of $y = |x + 3| + 1$ and $y = |x - 3| + 1$ are images of the graph $y = |x| + 1$ shifted 3 units right and left respectively.

e)



The graphs of $y = \frac{1}{x-2} + 4$ and $y = \frac{1}{x+2} + 4$ are images of the original $y = \frac{1}{x} + 4$ translated 2 units right and left respectively.

f)



$y = \sqrt{4 - (x-2)^2} + 3$ and $y = \sqrt{4 - (x+2)^2} + 3$ are images of $y = \sqrt{4 - x^2} + 3$ shifted 2 units right and left respectively.

17. **a)** The interest earned is equal to the principal times the interest rate, or Pi. The total amount is $P + Pi$, or $P(1 + i)$. Thus,

$100 = P(1 + i)$

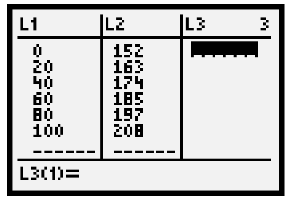
$P = \frac{100}{1 + i}$

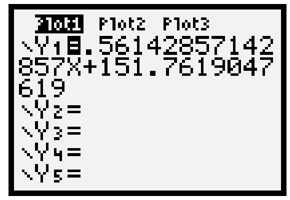
b) **i)** As i approaches 0 the value of the function spikes in similar fashion to the graph on page 7. Also very large i values result in small principal investment amounts.

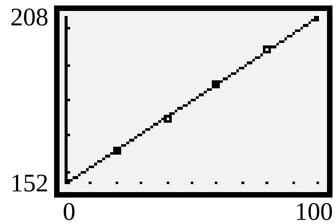
ii) The principal will not exceed 100 and the slope of the graph will be much smaller than the slope of the graph on page 7.

Selected Solutions — Chapter 1

18. b)







Modelling the Relation Between Volume and Temperature, page 24

- A gas can never have a volume of 0 mL.
- It puts the temperature for a volume of 0 mL at about 0˚ Kelvin, which is a temperature that can never physically be reached.

19. a) For example, start at the point (0, 0). If you move 3 units right and 2 units up, you are at the point (3, 2). If you move 3 units right and 2 units up again, you are at the point (6, 4). If you continue doing this, you get the points (9, 6), (12, 8), and so on. These points are all on the line $y = \frac{2}{3}x$. So if you translate any point on the line $y = \frac{2}{3}x$ right 3 units and up 2 units, the result is another point on the line.

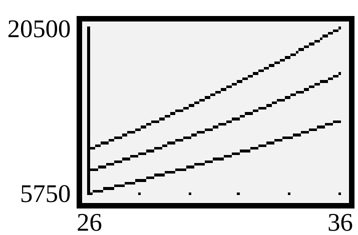
$$\begin{aligned} f(x-3)+2 &= \tfrac{2}{3}(x-3)+2 \\ &= \tfrac{2}{3}x-2+2 \\ &= \tfrac{2}{3}x \end{aligned}$$

b) All functions of the form $y = \frac{2}{3}x + b$ have this property.

$$\begin{aligned} f(x-3)+2 &= \tfrac{2}{3}(x-3)+2+b \\ &= \tfrac{2}{3}x-2+2+b \\ &= \tfrac{2}{3}x+b \end{aligned}$$

There is an infinite number of functions with this property.

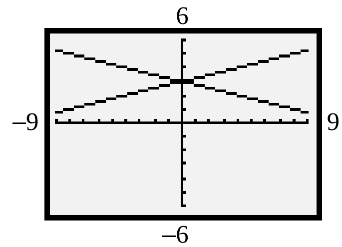
20. b)



Selected Solutions — Chapter 1

Investigate, page 25

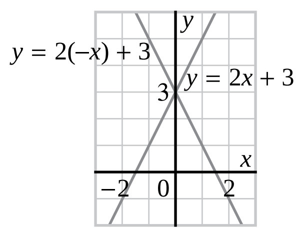
1. c)



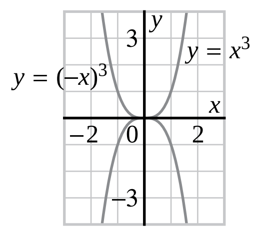
2. Yes. The graph of $y = -x$ is a reflection of $y = x$ in the y-axis, and likewise $y = (-x)^2$ is a reflection of $y = x^2$ in the y-axis.

3. b) The values of x that satisfy $y = f(x)$ when multiplied by the constant -1 produce the values of x that satisfy $y = f(-x)$. On a coordinate grid the affect of multiplying by -1 is a reflection about the y-axis.

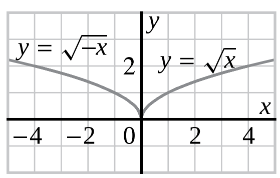
4. a)



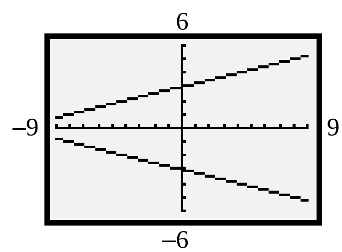
b)



c)



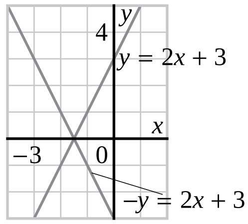
5. c)

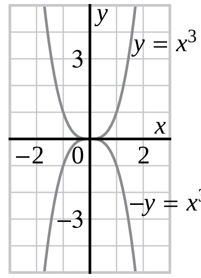


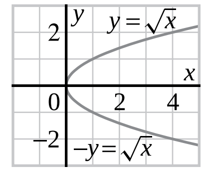
6. Yes. The graph of $-y = x$ is a reflection of the graph of $y = x$ in the x-axis, and the graph of $-y = x^2$ is a reflection of the graph of $y = x^2$ in the x-axis.

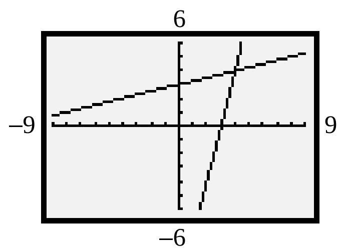
7. b) The values of y that satisfy $y = f(x)$ are the negative values of y that satisfy $-y = f(x)$.

Selected Solutions — Chapter 1

8. **a)** 

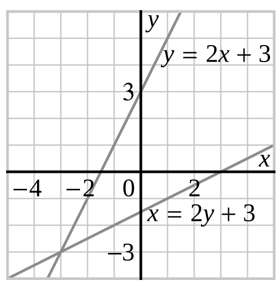
b) 

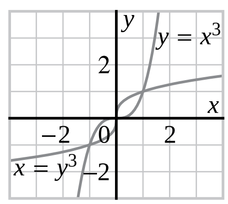
c) 

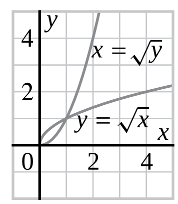
9. **c)** 

10. Yes. The graph of $y = x$ reflected in itself produces the graph of $y = x$, and the graph of $y = x^2$ is a reflection of the graph of $x = y^2$ in the line $y = x$.

11. **b)** The x-coordinate of one graph is equal to the corresponding y-coordinate on the other graph. In other words, (x, y) becomes (y, x).

12. **a)** 

b) 

c) 

1.3 Exercises, page 31

3. Reflecting a graph horizontally means flipping it over a vertical line. The x value is the changed coordinate. For example the point (–5, 3) reflected over the line $x = -2$ gives the point (1, 3). Reflecting a graph vertically means flipping it over a horizontal line. The y value is the changed coordinate. For example the point (–5, 3) reflected over the line $y = 1$ gives the point (–5, –1).

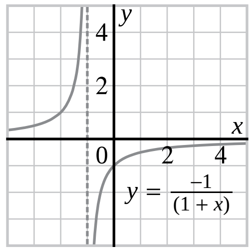
8. **a)** This is the graph of $y = \frac{1}{x}$ reflected in the x- or y-axis, then translated 1 unit right.

b) This is the graph of $y = \frac{1}{x}$ reflected in the x- or y-axis.

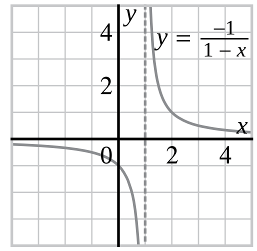
c) This is the graph of $y = \frac{1}{x}$ translated 1 unit left.

Selected Solutions — Chapter 1

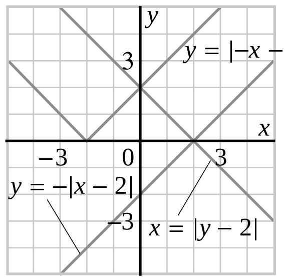
10. a)



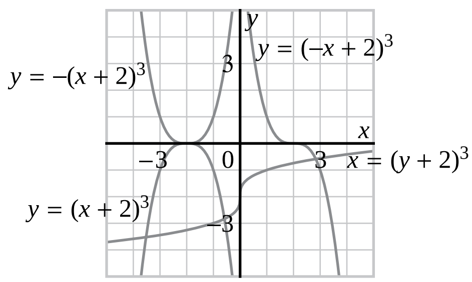
b)



11. a)

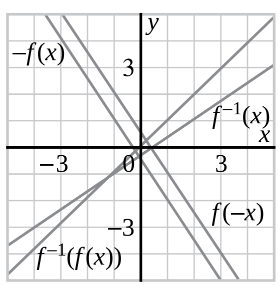


b)

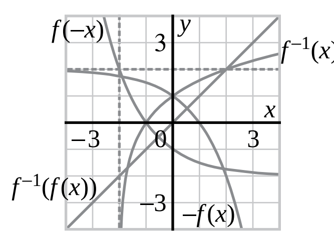


12. Explanations may vary. For exercise 11a:
First I graphed $y = |x - 2|$ by translating the graph of $y = |x|$ right 2 units. Then I reflected the graph of $y = |x - 2|$ in the y-axis to get the graph of $y = |-x - 2|$. Then I reflected the graph of $y = |x - 2|$ in the x-axis to get the graph of $y = -|x - 2|$. Then I reflected the graph of $y = |x - 2|$ in the line $y = x$ to get the graph of $x = |y - 2|$.

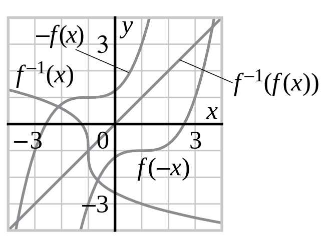
13. a)



b)



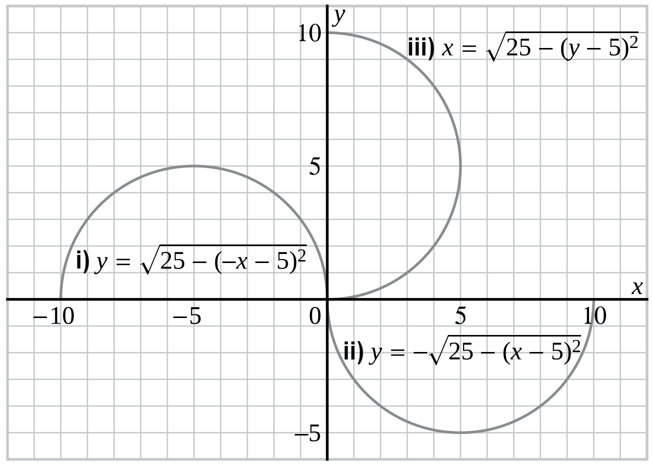
c)



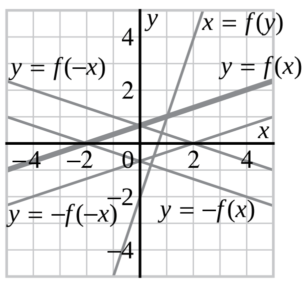
Selected Solutions — Chapter 1

14. a) The graph is a semicircle with centre (5, 0) and radius 5, obtained by translating the semicircle defined by $y = \sqrt{25 - x^2}$ right 5 units. This gives the equation $y = \sqrt{25 - (x - 5)^2}$.

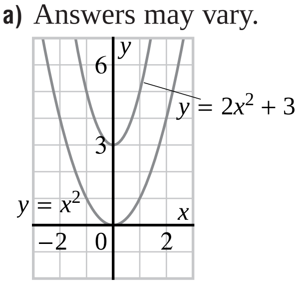
b)



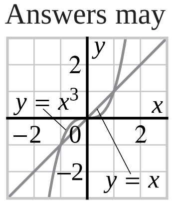
16. Diagrams may vary.



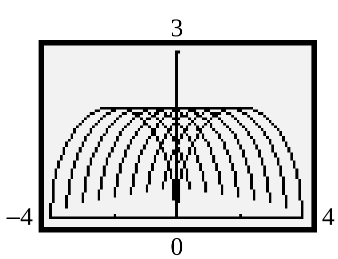
17. a) Answers may vary.



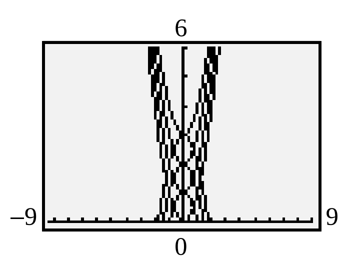
18. a) Answers may vary.



22. a)



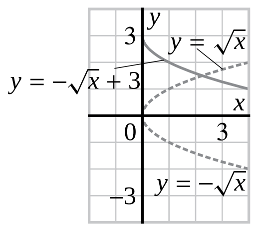
b)



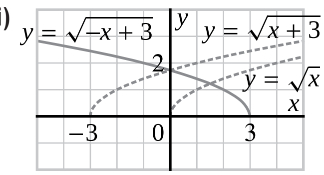
Selected Solutions — Chapter 1

23. Any function who's graph is pointwise symmetric about (0, 0) will produce the same function when reflected in either the x- or y-axis. Take $y = \pm\sqrt{25 - x^2}$ for example. Substitute $-y$ in for y and the function remains unchanged. Likewise substitute $-x$ for x and the same result follows. The function $y = x^3$ is another example. When either of the two variables is replaced by it's negative, the resulting function is $y = -x^3$.

24. a) i)



ii)

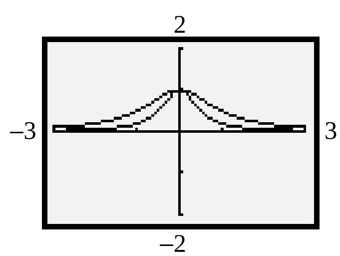


b) Explanations may vary. For part i:
First I sketched the graph of $y = \sqrt{x}$, which I reflected in the x-axis to get the graph of $y = -\sqrt{x}$. Then I translated the graph 3 units up to get the graph of $y = -\sqrt{x} + 3$, which is the same as $y = 3 - \sqrt{x}$.

For part ii:
First I sketched the graph of $y = \sqrt{x}$, which I translated 3 units left to get the graph of $y = \sqrt{x + 3}$. Then I reflected the graph in the y-axis to get the graph of $y = \sqrt{-x + 3}$, which is the same as $y = \sqrt{3 - x}$.

Investigate, page 35

1. c)



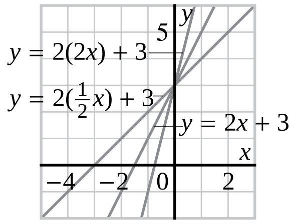
3. Yes. The graph of $y = 2x$ is a horizontal compression by a factor of $\frac{1}{2}$ of the graph of $y = x$. The graph of $y = (2x)^2$ is a horizontal compression by a factor of $\frac{1}{2}$ of the graph of $y = x^2$.

4. a) $\frac{1}{k}$ is the factor by which the graph of $y = f(kx)$ is compressed or expanded horizontally.

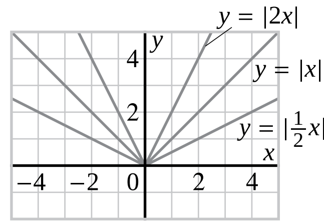
c) For $y = f(x)$ and $y = f(kx)$ to have the same value, the x-coordinate of $y = f(kx)$ has to be $\frac{1}{k}$ times the x-coordinate of $y = f(x)$.

Selected Solutions — Chapter 1

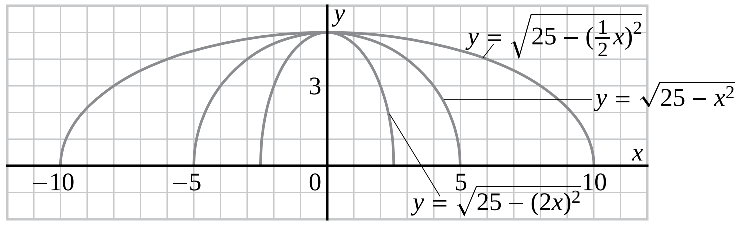
5. a)



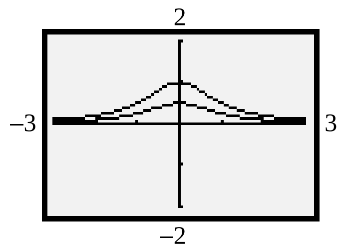
b)



c)



6. c)

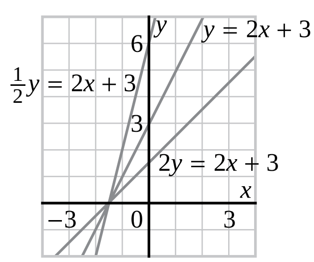


8. Yes. The graph of $2y = x$ is a vertical compression by a factor of $\frac{1}{2}$ of the graph of $y = x$. The graph of $2y = x^2$ is a vertical compression by a factor of $\frac{1}{2}$ of the graph of $y = x^2$.

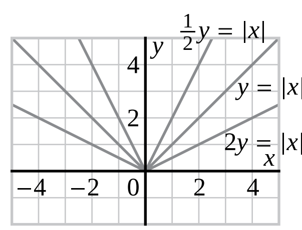
9. a) $\frac{1}{k}$ is the factor by which the graph of $ky = f(x)$ is compressed or expanded.

c) For $y = f(x)$ and $ky = f(x)$ to have the same value, the y value of $ky = f(x)$ has to be $\frac{1}{k}$ times the y value of $y = f(x)$.

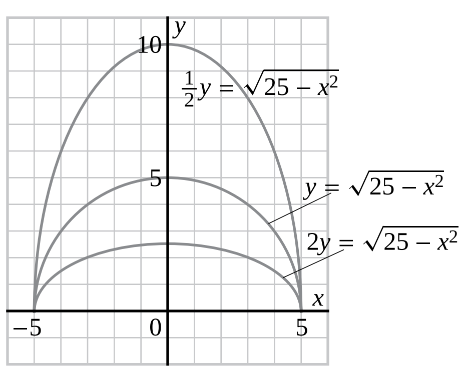
10. a)



b)



c)

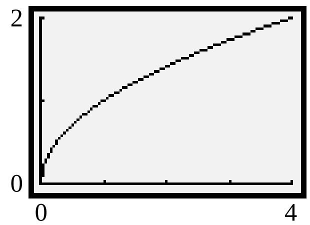


Selected Solutions — Chapter 1

1.4 Exercises, page 41

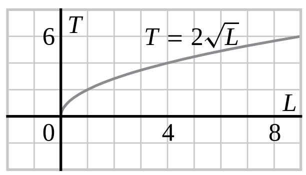
4. No. If the horizontal stretch is applied before the vertical stretch, $y = f(x)$ becomes $y = f(bx)$ and then $y = af(bx)$. If the vertical stretch is applied before the horizontal stretch, $y = f(x)$ becomes $y = af(x)$ and then $y = af(bx)$.

5. a)



c) For part i, $y = \sqrt{x}$ becomes $y = \sqrt{4x}$, or $y = 2\sqrt{x}$.
For part ii, $y = \sqrt{x}$ becomes $\frac{1}{2}y = \sqrt{x}$, or $y = 2\sqrt{x}$.

9. a)



Modelling the Period of a Pendulum, page 42

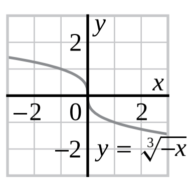
- $\frac{2\pi}{\sqrt{g}} \doteq 2$
- $\left(\frac{\pi}{g} - 1\right) \times 100\% = 0.35\%$
- The motion of a pendulum is along an arc of a circle.

10. a) This is the graph of a cube root centered at (0, 0) and passing through (–1, –1) and (1, 1).

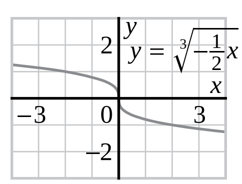
b) This is the graph of a cube root centered at (0, 0) with a horizontal compression.

c) This is the graph of a basic cube root reflected in the x-axis and horizontally compressed.

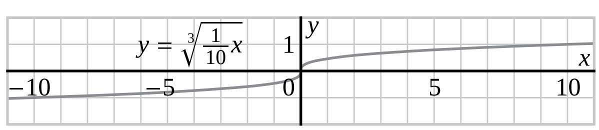
11. a)



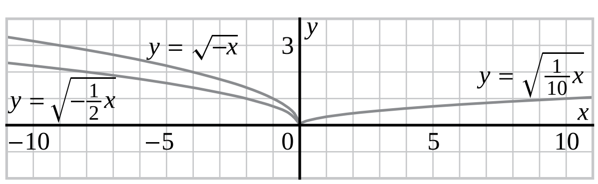
b



c)



12.



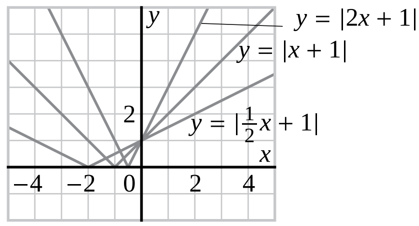
Selected Solutions — Chapter 1

13. Explanations may vary. For exercise 11a:
I sketched the reflection in the y-axis of the graph in exercise 10a.

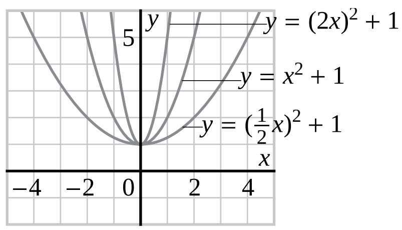
For exercise 11b:
I sketched the horizontal expansion by a factor of 4 of the graph in exercise 10c.

For exercise 11c:
I sketched the horizontal expansion by a factor of 20 of the graph in exercise 10c.

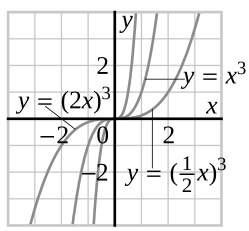
14. a)



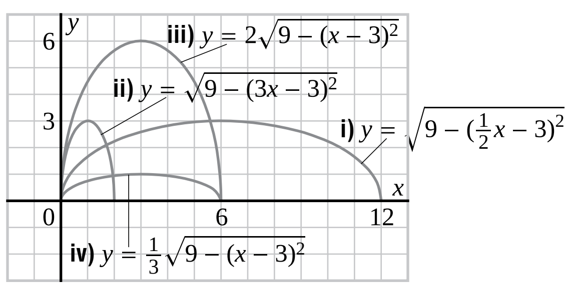
b)



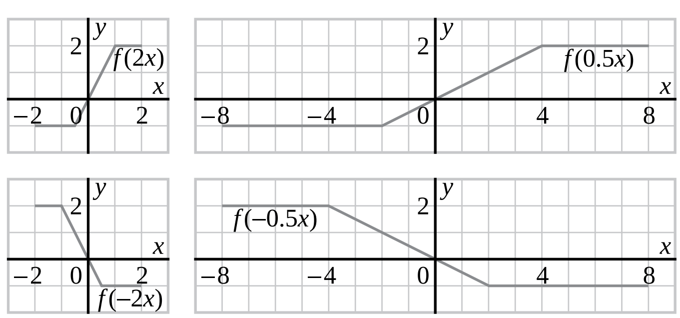
c)



16. a)

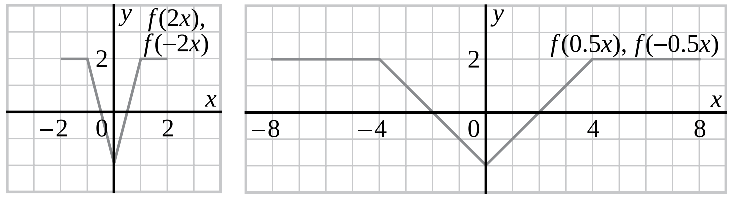


18. a)

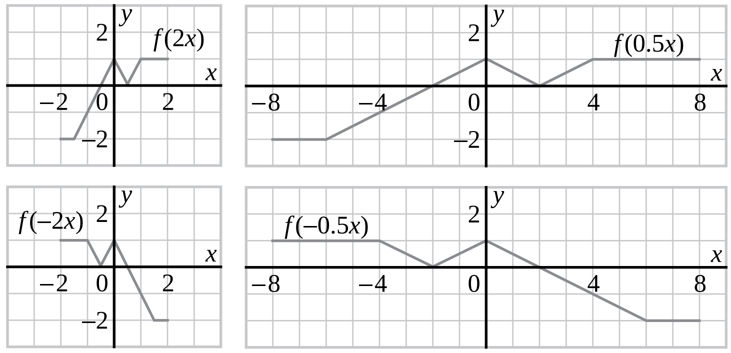


Selected Solutions — Chapter 1

b)

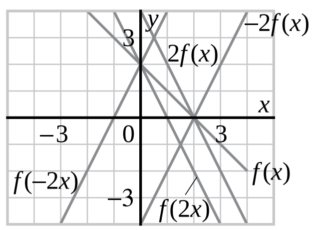


c)

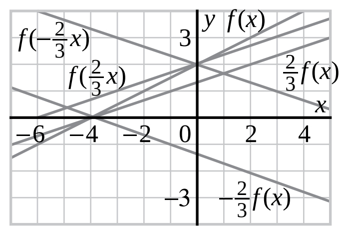


19. Diagrams may vary.

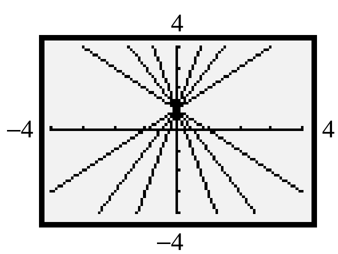
a)



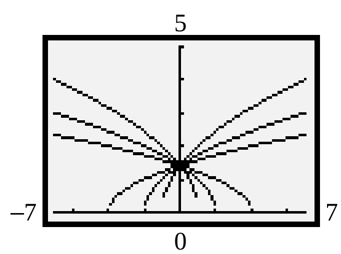
b)



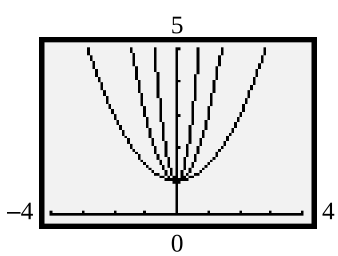
20. a)



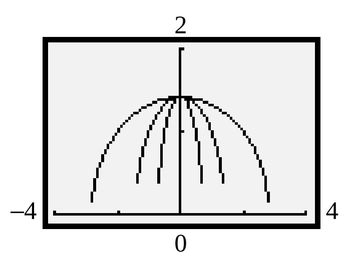
b)



c)

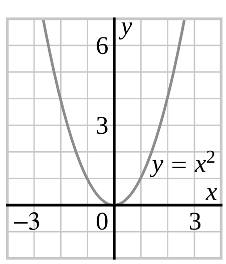


d)



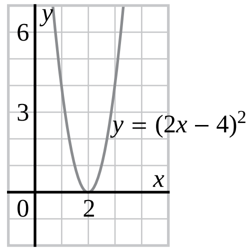
Investigate, page 45

1.

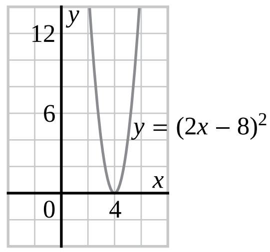


Selected Solutions — Chapter 1

2. b)



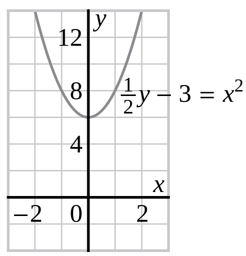
3. b)



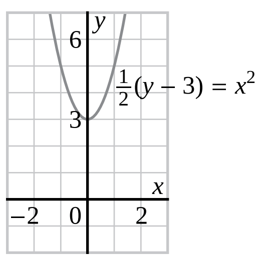
4. b) The opposite of the statement in part a can be disproved using this counterexample.

5. See exercise 1.

6. b)



7. b)

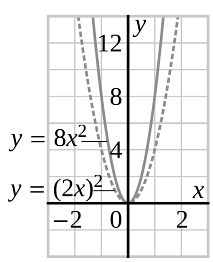


8. b) The opposite of the statement in part a can be disproved using this counterexample.

9. Horizontal compression: $y = (2x)^2$

Vertical expansion: $\frac{1}{2}y = (2x)^2$

$y = 8x^2$

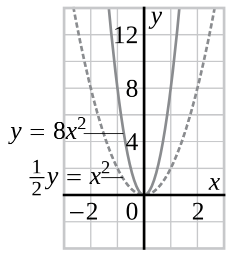


Selected Solutions — Chapter 1

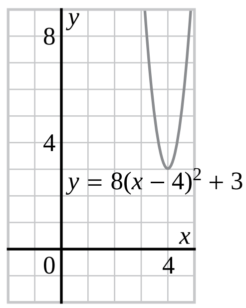
Vertical expansion: $\frac{1}{2}y = x^2$

Horizontal compression: $\frac{1}{2}y = (2x)^2$

$= 8x^2$

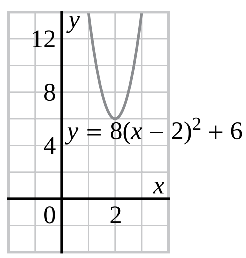


10. a)



b) See part a.

c)



d) See part c.

11. a) List the 24 possibilities. Let 1, 2, 3, and 4 represent the four translations HC, HT, VE, and VT:
1234, 1243, 1324, 1342, 1423, 1432, 2134, 2143, 2314, 2341, 2413, 2431, 3124, 3142, 3214, 3241, 3412, 3421, 4123, 4132, 4213, 4231, 4312, 4321.

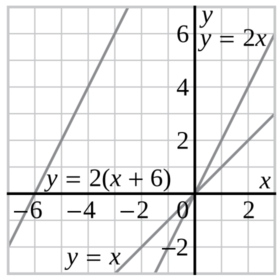
b) It is possible to switch the order of the following pairs of transformations without changing the resulting equation: HT, VE; HT, VT; HC, VT; HC, VE; or 2, 3; 2, 4; 1, 4; 1, 3. It is not possible to switch the order of the following pairs of transformations without changing the resulting equation: HC, HT; VE, VT; or 1, 2; 3, 4. Begin with 1234 and switch the order of the pairs of transformations which are guaranteed to produce a new equation. To veryify that you have exactly the right number of different equations, switch the order of the pairs within the four candidates so that the equations will not be changed. Eliminate the resulting permutations from the above list of 24 possibilities and you should be left with only 4 different equations.

Selected Solutions — Chapter 1

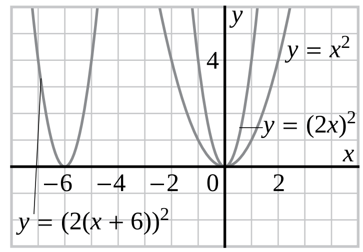
12. The function $y = x^2$ is symmetric about the y-axis and therefore has special properties. Since all functions are not symmetric about the y-axis, the results will not hold for all functions.

1.5 Exercises, page 51

4. a)



b)



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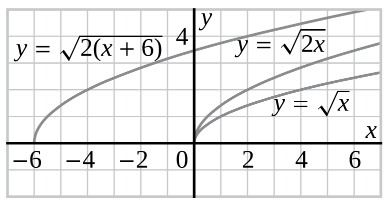
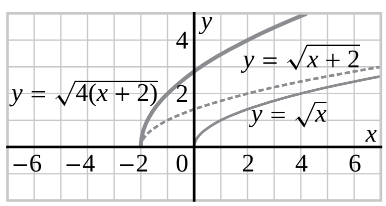


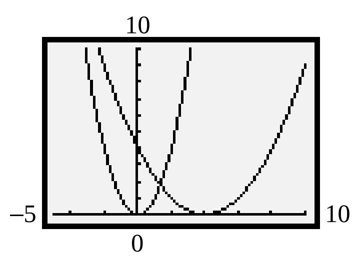
5. Explanations may vary. For part a:

First I sketched the graph of $y = x$. Then I compressed the graph horizontally by a factor of $\frac{1}{2}$ to get the graph of $= 2x$. Then I translated it 6 units left to get the graph of $y = 2(x + 6)$.

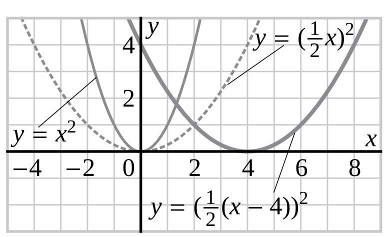
6. b)



7. a)

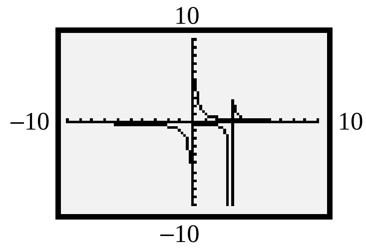


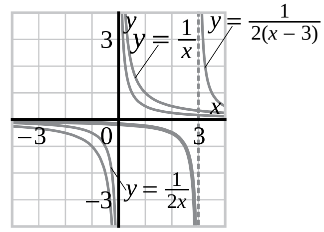
c)



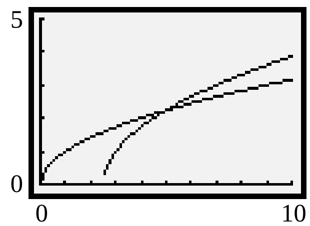
Selected Solutions — Chapter 1

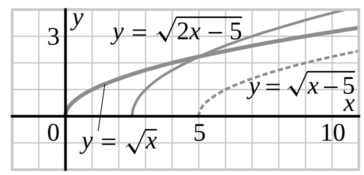
8. a)



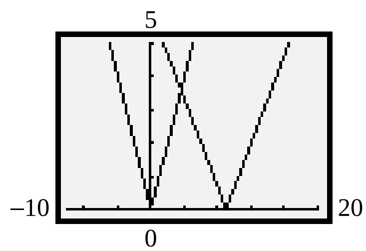


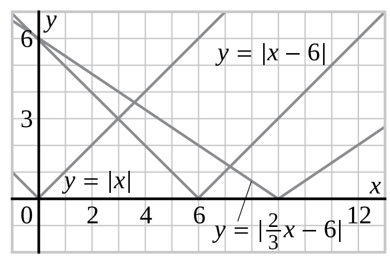
b)



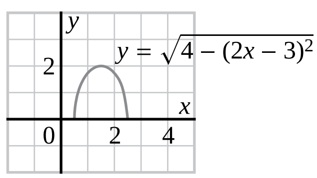


c)

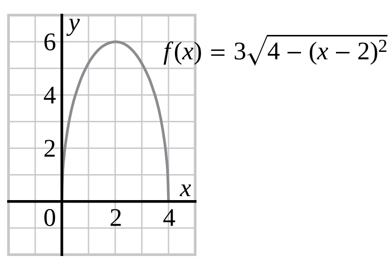




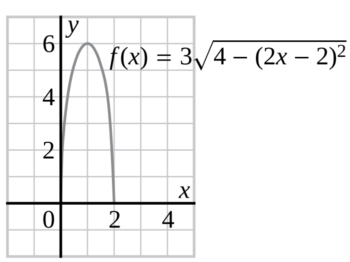
9. a) i)



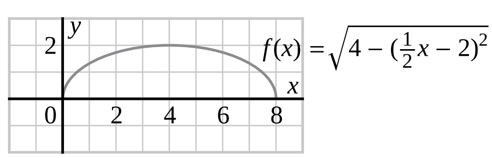
ii)

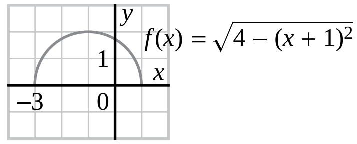


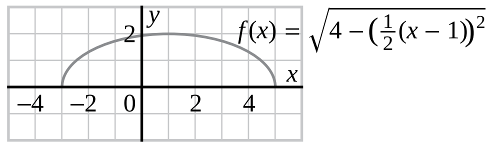
iii)

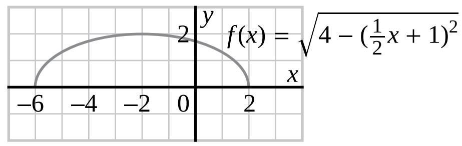


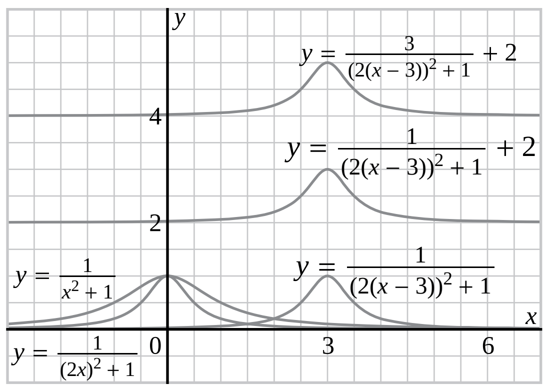
10. a) i)



ii) 

iii) 

iv) 

11. b) 

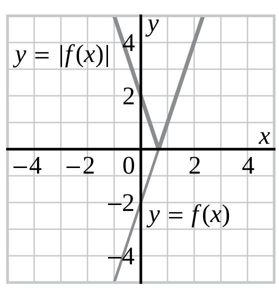
12. a) The vertical expansion by a factor of 3 precedes the vertical translation up 4 units. This is clear since the vertical translation is independent of the vertical expansion.

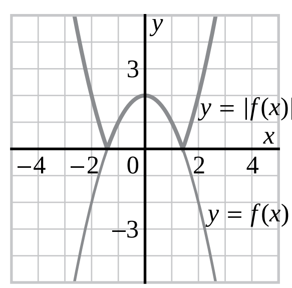
b) If the vertical translation were applied first and then the vertical expansion, the equation would be $y = 3(f(x) + 4)$, or $y = 3f(x) + 12$.

Exploring with a Graphing Calculator, page 53

3. Answers may vary. For example if $a = -260$ and $b = 33$, the sum of the squares is $130.04 > 129.49$.

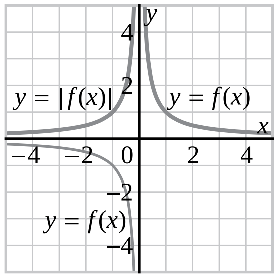
1.6 Exercises, page 57

1. a) 

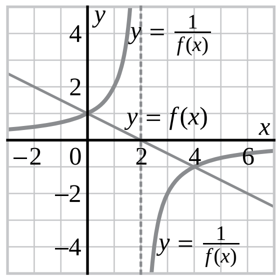
b) 

Selected Solutions — Chapter 1

c)



2. a)



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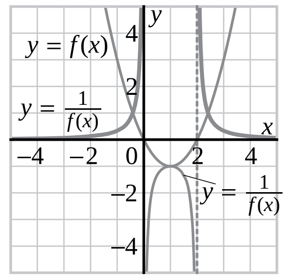
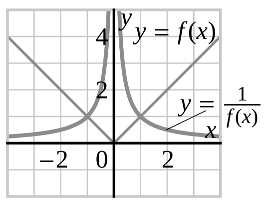


c)



3. a) This is the graph of a reciprocal function with vertical asymptotes $x = 0$ and $x = 4$.

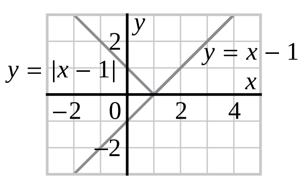
b) This is the graph of an absolute value function with x-intercept 2.

c) This is the graph of a reciprocal function. It starts at a specific point and goes in only one direction so it must be the reciprocal of a square root function.

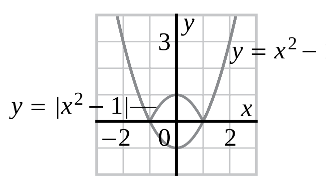
d) This is the graph of a reciprocal function with vertical asymptote $x = 2$.

e) This is the graph of an absolute value function with zeroes 0 and 4.

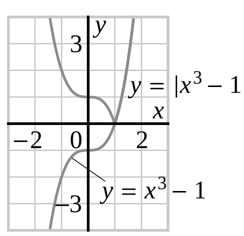
4. a)



b)



c)

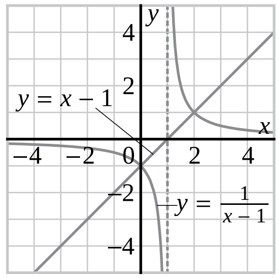


5. Explanations may vary. For part b:

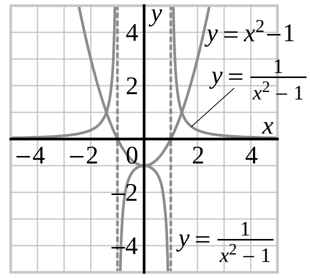
First I graphed $y = x^2 - 1$. Then I reflected the parts of the graph below the x-axis in the x-axis to obtain the graph of $y = |x^2 - 1|$.

Selected Solutions — Chapter 1

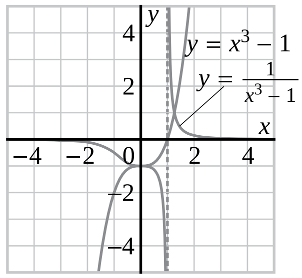
6. a)



b)



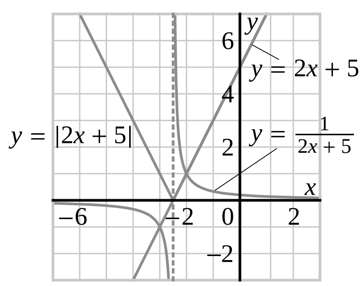
c)



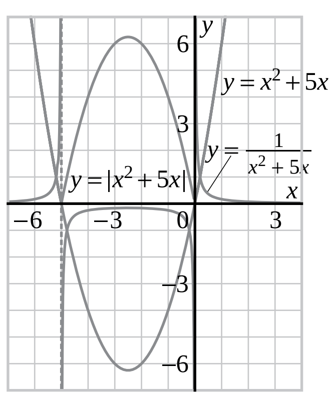
7. Explanations may vary. For part a:

First I graphed $y = x - 1$. For all points on this line which are above the line $y = 1$, I estimated the position of the corresponding point on the graph of $y = \frac{1}{x-1}$. These are between the x-axis and the line $y = 1$; points farther from the line $y = 1$ correspond to points closer to the x-axis. I followed this procedure for points between the x-axis and the line $y = 1$. The corresponding points lie above the line $y = 1$; points closer to the x-axis correspond to points farther from the line $y = 1$. At the intersection point of the line $y = x - 1$ and the x-axis, (1, 0), I determined there must be an asymptote $y = 1$ in the reciprocal function. For x values less than 1 on the line $y = x - 1$, I repeated the above estimation process to complete the graph of $y = \frac{1}{x-1}$.

8. a)

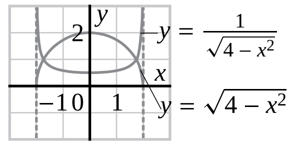


b)

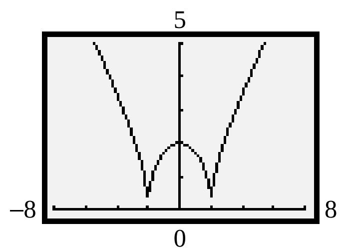


Selected Solutions — Chapter 1

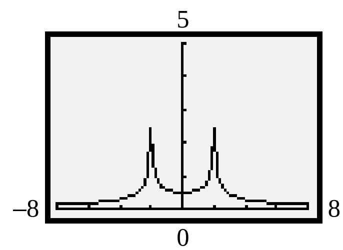
c)



9. a)

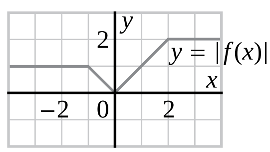


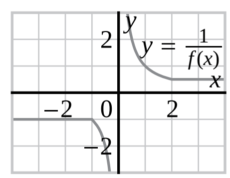
b)



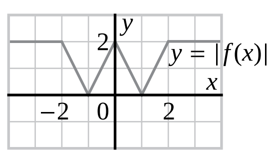
For $-2 \le x \le 2$, $y = \sqrt{|4 - x^2|}$ is the same as $y = \sqrt{4 - x^2}$, and $y = \dfrac{1}{\sqrt{|4 - x^2|}}$ is the same as $y = \dfrac{1}{\sqrt{4 - x^2}}$. The functions $y = \sqrt{|4 - x^2|}$ and $y = \dfrac{1}{\sqrt{|4 - x^2|}}$ are defined for $x < -2$ and $x > 2$, while $y = \sqrt{4 - x^2}$ and $y = \dfrac{1}{\sqrt{4 - x^2}}$ are not. This is because the absolute values are positive numbers.

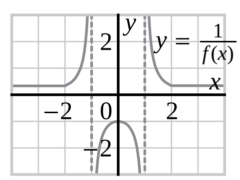
10. a)



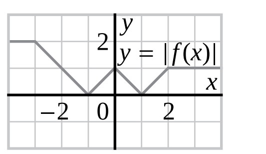


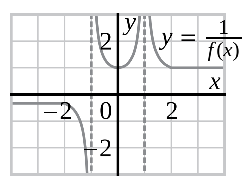
b)



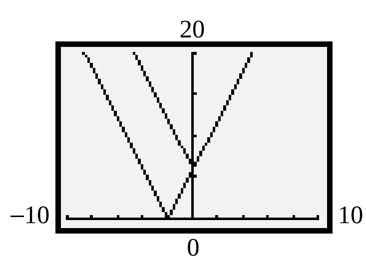


c)





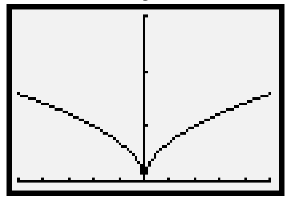
11. a)



The graphs are congruent, but $y = |3x + 6|$ has vertex (–6, 0), and $y = 3|x| + 6$ has vertex (0, 6).

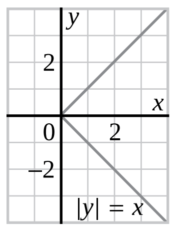
Selected Solutions — Chapter 1

b)

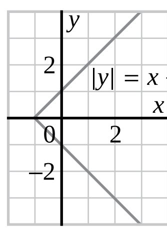


The graph of the function $y = \sqrt{|x|}$ is the same as the graph of $y = \sqrt{x}$ for $x \geq 0$. For $x < 0$ the graph of the function $y = \sqrt{|x|}$ has a branch that is the reflection in the y-axis of the graph of $y = \sqrt{x}$.

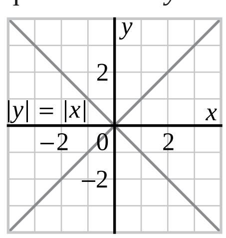
12. a) $y = \pm x$. This is the graph of $y = |x|$ reflected in the line $y = x$.



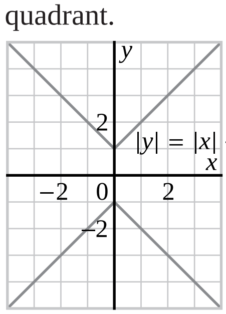
b) $y = \pm(x + 1)$. This is the graph of $y = |x| - 1$ reflected in the line $y = x$.



c) $y = \pm|x|$. For $y = |x|$ graph $y = x$ in the first quadrant and $y = -x$ in the second quadrant. For $y = -|x|$ graph $y = x$ in the third quadrant and $y = -x$ in the fourth quadrant.

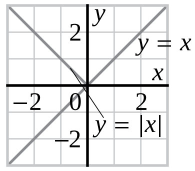


d) $y = \pm(|x| + 1)$. For $y = |x| + 1$ graph $y = x + 1$ in the first quadrant and $y = -x + 1$ in the second quadrant. For $y = -|x| - 1$ graph $y = x - 1$ in the third quadrant and $y = -x - 1$ in the fourth quadrant.



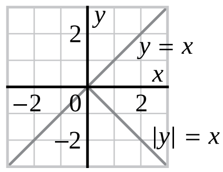
Selected Solutions — Chapter 1

13. a)



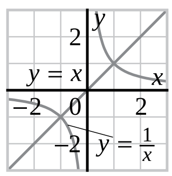
When x is replaced with $|x|$, the portion of the graph where $x < 0$ is reflected in the y-axis. This reflected image replaces all former $x < 0$ values.

b)



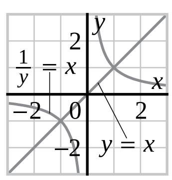
When y is replaced with $|y|$, there is a general reflection in the x-axis of all y-values. Both the reflected image and the former graph are retained.

c)



When x is replaced with $\frac{1}{x}$, all x-values where $|x| > 1$ are replaced by their reciprocal, so that as x increases, $\frac{1}{x}$ approaches the x-axis. Where $0 < |x| < 1$, as x gets smaller and smaller, the reciprocal of x rises vertically and approaches the y-axis.

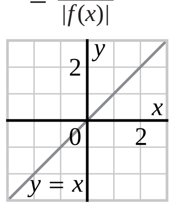
d)

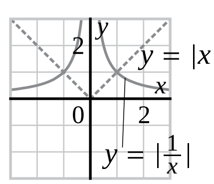


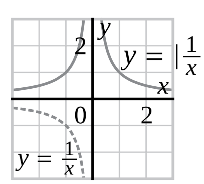
When y is replaced by $\frac{1}{y}$, all y-values where $|y| > 1$ are replaced by their reciprocal, so that as the former function value increases, the image function decreases and approaches the x-axis. Where $0 < |y| < 1$, as y gets smaller and smaller, the reciprocal of the former function value rises vertically and approaches the y-axis.

14. a) $y = \frac{1}{|f(x)|}$ is the reciprocal of the absolute value of $f(x)$. $y = \left|\frac{1}{f(x)}\right|$ is the absolute value of the reciprocal of $f(x)$.

b)
$$\begin{aligned} y &= \left|\frac{1}{f(x)}\right| \\ &= \frac{|1|}{|f(x)|} \\ &= \frac{1}{|f(x)|} \end{aligned}$$







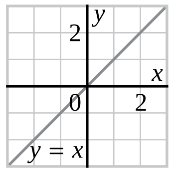
Selected Solutions — Chapter 1

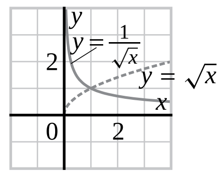
c) $y = \dfrac{1}{\sqrt{f(x)}}$ is the reciprocal of the square root of $f(x)$. $y = \sqrt{\dfrac{1}{f(x)}}$ is the square root of the reciprocal of $f(x)$.

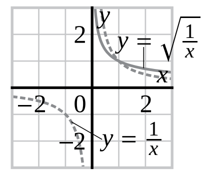
d) $y = \sqrt{\dfrac{1}{f(x)}}$

$= \dfrac{\sqrt{1}}{\sqrt{f(x)}}$

$= \dfrac{1}{\sqrt{f(x)}}$

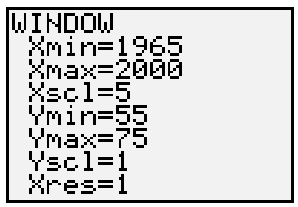




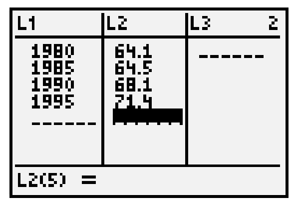


Mathematical Modelling, page 61

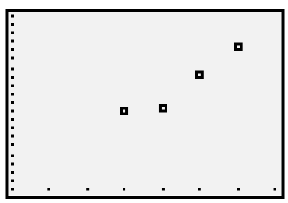
1. a)



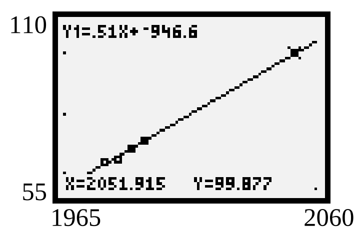
b)

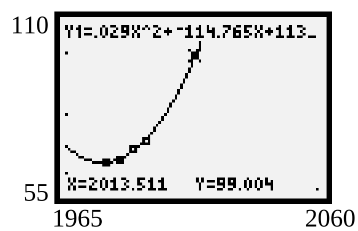


c)

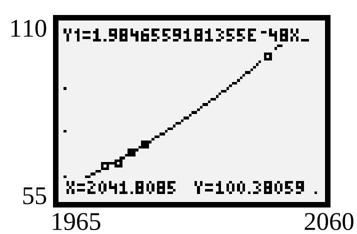


2. d)





3.

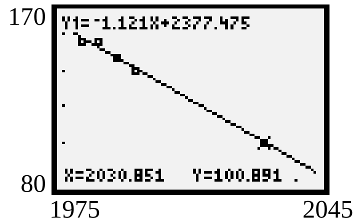


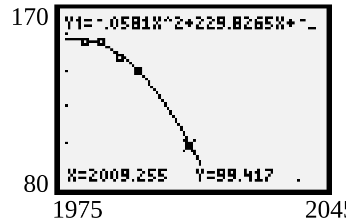
This is the PwrReg.

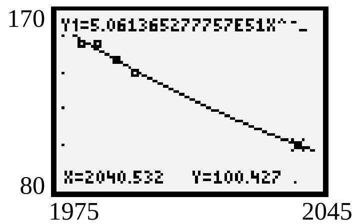
Selected Solutions — Chapter 1

4. a) The *y*-values would all be greater than 100%, but decreasing toward 100%.

   b) To calculate men's pay as a percent of women's, take the reciprocal of women's pay as a percent of men's.

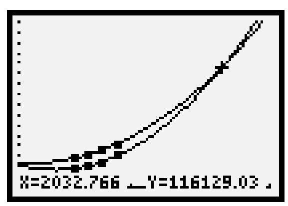
   c)




3.


5. The data points for exercise 4 are the reciprocal of the data points for exercise 2 and 3. Thus, as time passes, the curves in exercise 4 approach the *x*-axis, whereas the curves in exercises 2 and 3 move away from the *x*-axis.

6. a) The parabola of best fit for the females is $y = 0.029x^2 - 110.504x + 109\ 044.750$. The parabola of best fit for the males is $y = -0.05x^2 + 197.61x - 195\ 091.25$.

   b)


   Pay equity will occur in 2033.

7. No. Some of the regression models are poor estimates of *x*-values outside the data given. For example, the cubic regression suggests equality occurred in 1967.

Problem Solving, page 62

Answers may vary.

1. The graph on the left shows the number of Indonesian Rupiahs for every Canadian dollar between April 1, 1997, and March 31, 1998. The graph on the right shows the number of Canadian dollars for every U.S. dollar between April 1, 1997, and March 31, 1998.

2. a) The number of Rupiahs for every Canadian dollar increased from about 3000 to 9500.

Selected Solutions — Chapter 1

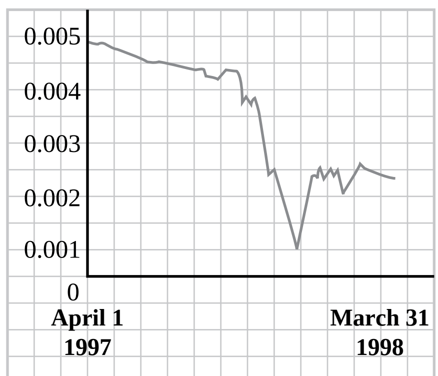
b) The range of the second graph is \$1.36 U.S. dollars to \$1.46. This is a 7.9% increase, which is not enough to show a collapse in the economy.

3. **a)** The vertical axis could be the percent change in the exchange rate, with April 1, 1997, as the base amount. Another approach would be to make the vertical axis a uniform currency.

b) If the vertical axis were a uniform currency, it would be impossible to see one of the graphs since the exchange rate between Canadian and U.S. funds is so small, but the exchange rate between the Rupiah and Canadian and/or U.S. is so large.

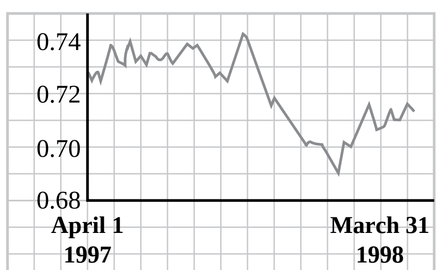
4. **a)** The graph would have vertical scale from 0 to $\frac{1}{2000}$, or 0.0005. With this scale, it would look like the graph of \$1 Can. in Rupiahs upside down.

One Indonesian Rupiah in Canadian Dollars



b) The graph would have vertical scale from 0.68 to 0.74. With this scale, it would look like the graph of \$1 U.S. in Canadian dollars upside down.

\$ Can. in U.S. Dollars



5. If the graph of \$1 U.S. in Canadian dollars was drawn with the same scale as the graph of \$1 Can. in Rupiahs, it would be a straight line. Thus, the graph of \$1 U.S. in Rupiahs would look very similar to the graph of \$1 Can. in Rupiahs. The range of the new graph would be increased slightly as compared to the former range.

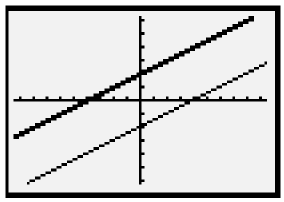
Selected Solutions — Chapter 1

1 Review

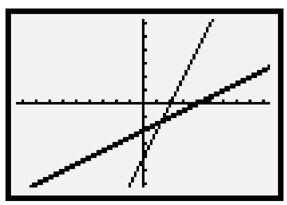
1. b) It looks like a horizontal line at $y = 8.5$, since the length of the steel girder is hardly effected by changes in temperature.

c) The first number, 8.5 m, is the length of the girder at room temperature, or 20˚C. The second number, 1.2×10^{-5}, represents the change in length per degree increase in temperature.

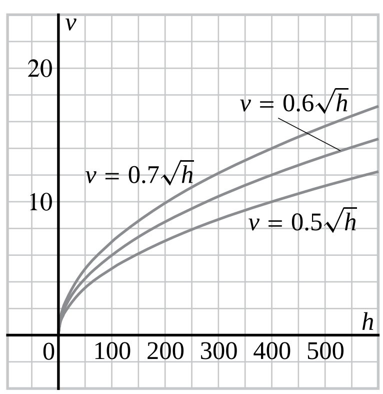
3. a) By replacing the x with $-x$ and the y with $-y$, the resulting graph is reflected through the origin. For example, the image of the graph for $y = \frac{1}{2}x - 2$ is $y = \frac{1}{2}x + 2$ as shown in the screen below.



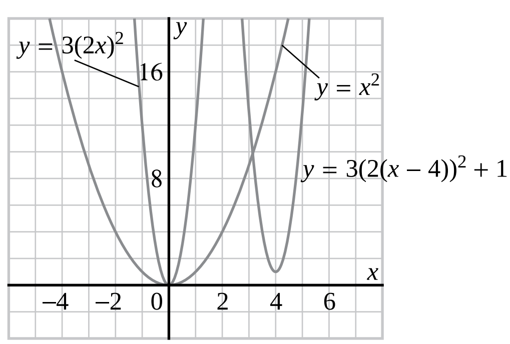
b) By replacing the x with $-y$ and the y with $-x$, the resulting graph is reflected through the line $y = -x$. For example, the image of the graph for $y = 2x - 4$ is $y = \frac{1}{2}x - 2$ as shown in the screen below.



4.

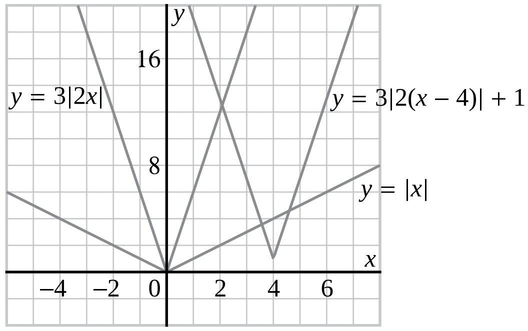


5. a)



Selected Solutions — Chapter 1

b)



c)