c) Substituting 367,200 for N we have

$$367{,}200 = 1.02P$$
$$\frac{367{,}200}{1.02} = P$$
$$360{,}000 = P$$

The previous population was 360,000.

88. a) $A(t) = 0.08t + 19.7$

$A(0) = 0.08(0) + 19.7 = 19.7$

The median age of woman at first marriage in 1950 was 19.7 years old.

$A(1) = 0.08(1) + 19.7 = 19.78$

The median age of woman at first marriage in 1951 was 19.78 years old.

$A(10) = 0.08(10) + 19.7 = 20.5$

The median age of woman at first marriage in 1960 was 20.5 years old.

$A(30) = 0.08(30) + 19.7 = 22.1$

The median age of woman at first marriage in 1980 was 22.1 years old.

$A(50) = 0.08(50) + 19.7 = 23.7$

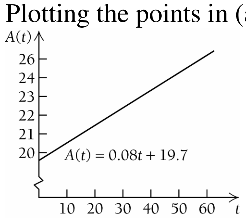
The median age of woman at first marriage in 200 was 23.7 years old.

b) In 2008, $t = 2008 - 1950 = 58$

$A(58) = 0.08(58) + 19.7 = 24.34$

The median age of women at first marriage in 2008 will be 24.34 years old.

c) Plotting the points in (a) part we have:



89. $\boxed{tw}$ Answers may vary. When the slope of the line and the y-intercept is known, the slope-intercept equation is preferable. The point-slope equation is preferable when two points on a line or one point (that is not the y-intercept) and the slope of a line are known.

90. $\boxed{tw}$ Answers may vary. The discussion should include the information on how total cost is composed of two components, fixed and variable costs. Fixed costs are the component of total cost not dependent upon output. The discussion should also include knowledge that total revenue is price times quantity sold, and total profit is total revenue minus total costs.

91. a) Graph III is appropriate, because it shows the rate before January 1 is approximately \$3000 per month, and the rate after January 1 is approximately \$2000 per month.

b) Graph IV is appropriate, because it shows the rate before January 1 is approximately \$3000 per month, and the rate after January 1 is approximately –\$4000 per month.

c) Graph I is appropriate, because it shows the rate before January 1 is approximately \$1000 per month, and the rate after January 1 is approximately \$2000 per month.

d) Graph II is appropriate, because it shows the rate before January 1 is approximately \$4000 per month, and the rate after January 1 is approximately –\$2000 per month.

92. Answers may vary. Regions of profit will occur when total revenue is greater than total cost, or when total profit is above the x-axis. Regions of loss will occur when total revenue is less than total cost, or when total profit is below the x-axis.

Exercise Set R.5

1. Graph $y = \frac{1}{2}x^2$ and $y = -\frac{1}{2}x^2$.

Starting with $y = \frac{1}{2}x^2$, we first find the vertex or the turning point. The x-coordinate of the vertex is

$$x = -\frac{b}{2a} = -\frac{0}{2\left(\frac{1}{2}\right)} = 0$$

Substituting 0 for x into the equation, we find the second coordinate of the vertex:

$y = \frac{1}{2}(0)^2 = 0$.

The vertex is $(0,0)$. The y-axis (The vertical line $x = 0$.) is the axis of symmetry. Next, we choose some x-values on each side of the vertex and compute the y-values.

When $x = 1, y = \frac{1}{2}(1)^2 = \frac{1}{2}\cdot 1 = \frac{1}{2}$

When $x = 2, y = \frac{1}{2}(2)^2 = \frac{1}{2}\cdot 4 = 2$

When $x = -1, y = \frac{1}{2}(-1)^2 = \frac{1}{2}\cdot 1 = \frac{1}{2}$

When $x = -2, y = \frac{1}{2}(-2)^2 = \frac{1}{2}\cdot 4 = 2$

x	y
0	0
1	$\frac{1}{2}$
2	2
–1	$\frac{1}{2}$
–2	2

We plot these points and connect them with a smooth curve on the axis below.

Next, we graph $y = -\frac{1}{2}x^2$. First, we find the vertex or the turning point. The x-coordinate of the vertex is

$$x = -\frac{b}{2a}$$

$$x = -\frac{0}{2\left(-\frac{1}{2}\right)} = 0$$

Substituting 0 for x into the equation, we find the second coordinate of the vertex:

$y = -\frac{1}{2}(0)^2 = 0$.

The vertex is $(0,0)$. The y-axis (The vertical line $x = 0$.) is the axis of symmetry. Next, we choose some x-values on each side of the vertex and compute the y-values.

When $x = 1, y = -\frac{1}{2}(1)^2 = -\frac{1}{2}\cdot 1 = -\frac{1}{2}$

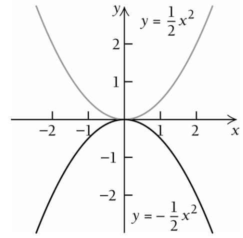
When $x = 2, y = -\frac{1}{2}(2)^2 = -\frac{1}{2}\cdot 4 = -2$

When $x = -1, y = -\frac{1}{2}(-1)^2 = -\frac{1}{2}\cdot 1 = -\frac{1}{2}$

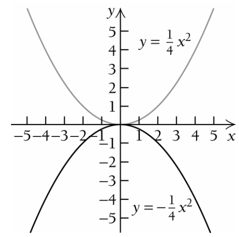
When $x = -2, y = -\frac{1}{2}(-2)^2 = -\frac{1}{2}\cdot 4 = -2$

x	y
0	0
1	$-\frac{1}{2}$
2	–2
–1	$-\frac{1}{2}$
–2	–2

We plot these points and connect them with a smooth curve on the axis below.



2. Graph $y = \frac{1}{4}x^2$ and $y = -\frac{1}{4}x^2$.



3. Graph $y = x^2$ and $y = x^2 - 1$.

Starting with $y = x^2$, we first find the vertex or the turning point. The x-coordinate of the vertex is

$$x = -\frac{b}{2a} = -\frac{0}{2(1)} = 0$$

Substituting 0 for x into the equation, we find the second coordinate of the vertex:

$y = (0)^2 = 0$.

The vertex is $(0,0)$. The y-axis (The vertical line $x = 0$.) is the axis of symmetry. Next, we choose some x-values on each side of the vertex and compute the y-values.

When $x = 1, y = (1)^2 = 1$

When $x = 2, y = (2)^2 = 4$

When $x = -1, y = (-1)^2 = 1$

When $x = -2, y = (-2)^2 = 4$

x	y
0	0
1	1
2	4
–1	1
–2	4

We plot these points and connect them with a smooth curve on the axis below.

Next, we graph $y = x^2 - 1$. First, we find the vertex or the turning point. The x-coordinate of the vertex is

$$x = -\frac{b}{2a}$$
$$= -\frac{0}{2(1)}$$
$$= 0$$

Substituting 0 for x into the equation, we find the second coordinate of the vertex:

$y = (0)^2 - 1 = -1$.

The vertex is $(0, -1)$. The y-axis (The vertical line $x = 0$.) is the axis of symmetry. Next, we choose some x-values on each side of the vertex and compute the y-values.

When $x = 1, y = (1)^2 - 1 = 1 - 1 = 0$

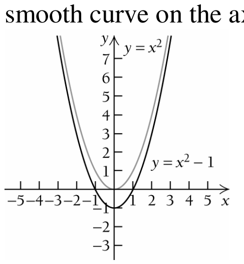
When $x = 2, y = (2)^2 - 1 = 4 - 1 = 3$

When $x = -1, y = (-1)^2 - 1 = 1 - 1 = 0$

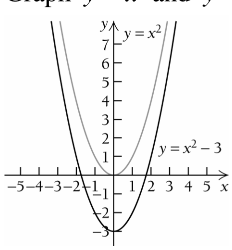
When $x = -2, y = (-2)^2 - 1 = 4 - 1 = 3$

x	y
0	–1
1	0
2	3
–1	0
–2	3

We plot these points and connect them with a smooth curve on the axis below.



4. Graph $y = x^2$ and $y = x^2 - 3$.



5. Graph $y = -2x^2$ and $y = -2x^2 + 1$.

Starting with $y = -2x^2$, we first find the vertex or the turning point. The x-coordinate of the vertex is:

$$x = -\frac{b}{2a}$$
$$= -\frac{0}{2(-2)}$$
$$= 0$$

Substituting 0 for x into the equation, we find the second coordinate of the vertex:

$y = -2(0)^2 = 0$.

The vertex is $(0, 0)$. The y-axis (The vertical line $x = 0$.) is the axis of symmetry. Next, we choose some x-values on each side of the vertex and compute the y-values.

When $x = 1, y = -2(1)^2 = -2 \cdot 1 = -2$

When $x = 2, y = -2(2)^2 = -2 \cdot 4 = -8$

When $x = -1, y = -2(-1)^2 = -2 \cdot 1 = -2$

When $x = -2, y = -2(-2)^2 = -2 \cdot 4 = -8$

x	y
0	0
1	–2
2	–8
–1	–2
–2	–8

We plot these points and connect them with a smooth curve on the next page.

Next, we graph $y = -2x^2 + 1$. First, we find the vertex or the turning point. The x-coordinate of the vertex is

$$x = -\frac{b}{2a}$$
$$= -\frac{0}{2(-2)}$$
$$= 0$$

Substituting 0 for x into the equation, we find the second coordinate of the vertex:

$y = -2(0)^2 + 1 = 1$.

The vertex is $(0, 1)$. The y-axis (The vertical line $x = 0$.) is the axis of symmetry. Next, we choose some x-values on each side of the vertex and compute the y-values.

When $x = 1, y = -2(1)^2 + 1 = -2 + 1 = -1$

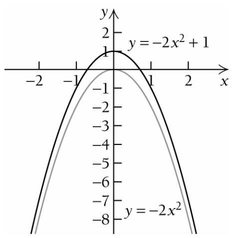
When $x = 2, y = -2(2)^2 + 1 = -8 + 1 = -7$

When $x = -1, y = -2(-1)^2 + 1 = -2 + 1 = -1$

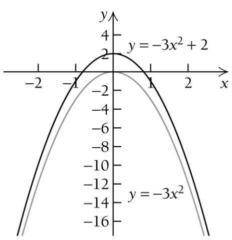
When $x = -2, y = -2(-2)^2 + 1 = -8 + 1 = -7$

x	y
0	1
1	–1
2	–7
–1	–1
–2	–7

We plot these points and connect them with a smooth curve on the axis below.



6. Graph $y = -3x^2$ and $y = -3x^2 + 2$.



7. Graph $y = |x|$ and $y = |x - 3|$.

Starting with $y = |x|$, we choose some x-values and compute the y-values to make a table of points.

When $x = -2, y = |-2| = -(-2) = 2$

When $x = -1, y = |-1| = -(-1) = 1$

When $x = 0, y = |0| = 0$

When $x = 1, y = |1| = 1$

When $x = 2, y = |2| = 2$

x	y
–2	2
–1	1
0	0
1	1
2	2

We plot these points and connect them with a smooth curve on the axis at the top of the next column.

Next, we graph $y = |x - 3|$. We choose some x-values and compute the y-values to make a table of points.

When $x = -2, y = |-2 - 3| = |-5| = -(-5) = 5$

When $x = 0, y = |0 - 3| = |-3| = -(-3) = 3$

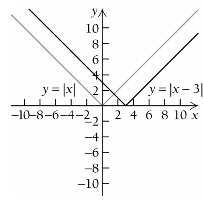
When $x = 3, y = |3 - 3| = |0| = 0$

When $x = 6, y = |6 - 3| = |3| = 3$

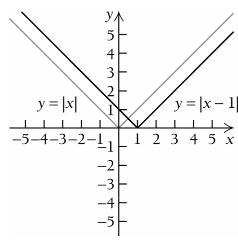
When $x = 8, y = |8 - 3| = |5| = 5$

x	y
–2	5
0	3
3	0
6	3
8	5

We plot these points and connect them with a smooth curve on the axis below.



8. Graph $y = |x|$ and $y = |x - 1|$.



9. Graph $y = x^3$ and $y = x^3 + 2$.

Starting with $y = x^3$, we choose some x-values and compute the y-values to make a table of points.

When $x = -2, y = (-2)^3 = -8$

When $x = -1, y = (-1)^3 = -1$

When $x = 0, y = (0)^3 = 0$

When $x = 1, y = (1)^3 = 1$

When $x = 2, y = (2)^3 = 8$

x	y
–2	–8
–1	–1
0	0
1	1
2	8

We plot the points from the previous page and connect them with a smooth curve on the axis below.

Next, we graph $y = x^3 + 2$. We choose some x-values and compute the y-values to make a table of points.

When $x = -2, y = (-2)^3 + 2 = -8 + 2 = -6$

When $x = -1, y = (-1)^3 + 2 = -1 + 2 = 1$

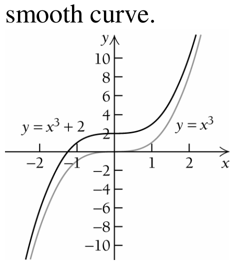
When $x = 0, y = (0)^3 + 2 = 0 + 2 = 2$

When $x = 1, y = (1)^3 + 2 = 1 + 2 = 3$

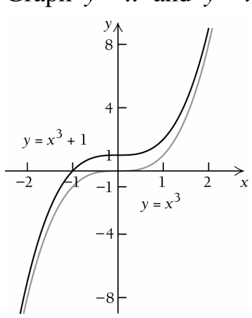
When $x = 2, y = (2)^3 + 2 = 8 + 2 = 10$

x	y
–2	–6
–1	1
0	2
1	3
2	10

We plot these points and connect them with a smooth curve.



10. Graph $y = x^3$ and $y = x^3 + 1$.



11. Graph $y = \sqrt{x}$ and $y = \sqrt{x-1}$.

Starting with $y = \sqrt{x}$, we choose some x-values and compute the y-values to make a table of points. The domain of the function is the set of all nonnegative real numbers, so we choose x-values that are in the set $[0, \infty)$.

When $x = 0, y = \sqrt{0} = 0$

When $x = 1, y = \sqrt{1} = 1$

When $x = 4, y = \sqrt{4} = 2$

When $x = 9, y = \sqrt{9} = 3$

x	y
0	0
1	1
4	2
9	3

We plot these points and connect them with a smooth curve on the axis below.

Next, we graph $y = \sqrt{x-1}$. we choose some x-values and compute the y-values to make a table of points. The domain of the function is the set of all positive real numbers greater than or equal to 1, so we choose x-values that are in the set $[1, \infty)$

When $x = 1, y = \sqrt{1-1} = \sqrt{0} = 0$

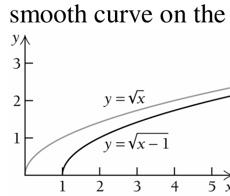
When $x = 2, y = \sqrt{2-1} = \sqrt{1} = 1$

When $x = 5, y = \sqrt{5-1} = \sqrt{4} = 2$

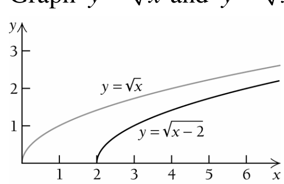
When $x = 10, y = \sqrt{10-1} = \sqrt{9} = 3$

x	y
1	0
2	1
5	2
10	3

We plot these points and connect them with a smooth curve on the axis below.



12. Graph $y = \sqrt{x}$ and $y = \sqrt{x-2}$.



13. $y = x^2 + 4x - 7$

This function is of the form $y = ax^2 + bx + c,\ a \neq 0$, so its graph is a parabola.

We have $a = 1$ and $b = 4$, so the first coordinate of the vertex is

$$x = -\frac{b}{2a}$$
$$= -\frac{4}{2(1)} = -2.$$

Substituting -2 into the equation, we find the second coordinate of the vertex:

$$y = (-2)^2 + 4(-2) - 7$$
$$= 4 - 8 - 7$$
$$= -11.$$

The vertex is $(-2, -11)$.

14. $y = x^3 - 2x + 3$

The function is not of the form $y = ax^2 + bx + c,\ a \neq 0$, so its graph is not a parabola.

15. $y = 2x^4 - 4x^2 - 3$

The function is not of the form $y = ax^2 + bx + c,\ a \neq 0$, so its graph is not a parabola.

16. $y = 3x^2 - 6x$

This function is of the form $y = ax^2 + bx + c,\ a \neq 0$, so its graph is a parabola.

We have $a = 3$ and $b = -6$, so the first coordinate of the vertex is

$$x = -\frac{b}{2a} = -\frac{-6}{2(3)} = 1.$$

Substituting 1 into the equation, we find the second coordinate of the vertex:

$$y = 3(1)^2 - 6(1)$$
$$= -3.$$

The vertex is $(1, -3)$.

17. Graph $y = x^2 - 4x + 3$.

First, we should recognize that this function is a quadratic function. We find the vertex or the turning point. The x-coordinate of the vertex is

$$x = -\frac{b}{2a}$$
$$= -\frac{-4}{2(1)}$$
$$= 2$$

Substituting 2 for x into the equation, we find the second coordinate of the vertex:

$$y = (2)^2 - 4(2) + 3$$
$$= 4 - 8 + 3 = -1.$$

The vertex is $(2, -1)$. The vertical line $x = 2$ is the axis of symmetry. Next, we choose some x-values on each side of the vertex and compute the y-values.

When $x = -1,\ y = (-1)^2 - 4(-1) + 3 = 8$

When $x = 0,\ y = (0)^2 - 4(0) + 3 = 3$

When $x = 1,\ y = (1)^2 - 4(1) + 3 = 0$

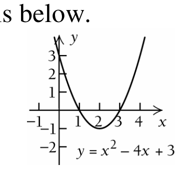
When $x = 3,\ y = (3)^2 - 4(3) + 3 = 0$

When $x = 4,\ y = (4)^2 - 4(4) + 3 = 3$

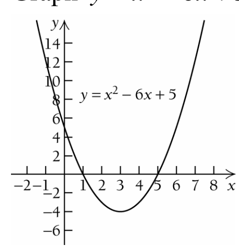
When $x = 5,\ y = (5)^2 - 4(5) + 3 = 8$

x	y
-1	8
0	3
1	0
2	-1
3	0
4	3
5	8

We plot these points and connect them with a smooth curve on the axis below.



18. Graph $y = x^2 - 6x + 5$.



19. Graph $y = -x^2 + 2x - 1$.

First, we should recognize that this function is a quadratic function. We find the vertex or the turning point. The x-coordinate of the vertex is

$$x = -\frac{b}{2a} = -\frac{2}{2(-1)} = 1$$

Substituting 1 for x into the equation, we find the second coordinate of the vertex:

$$y=-(1)^2+2(1)-1$$
$$=-1+2-1=0.$$

The vertex is $(1,0)$. The vertical line $x=1$ is the axis of symmetry. Next, we choose some x-values on each side of the vertex and compute the y-values.

When $x=-1$, $y=-(-1)^2+2(-1)-1=-4$

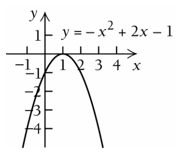
When $x=\ \ 0$, $y=-(0)^2+2(0)-1=-1$

When $x=\ \ 2$, $y=-(2)^2+2(2)-1=-1$

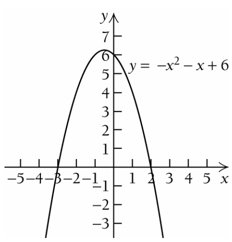
When $x=\ \ 3$, $y=-(3)^2+2(3)-1=-4$

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

We plot these points and connect them with a smooth curve on the axis below.



20. Graph $y=-x^2-x+6$.



21. Graph $f(x)=2x^2-6x+1$.

First, we should recognize that this function is a quadratic function. We find the vertex or the turning point. The x-coordinate of the vertex is

$$x=-\frac{b}{2a}=-\frac{-6}{2(2)}=\frac{3}{2}$$

Substituting $3/2$ for x into the equation, we find the second coordinate of the vertex:

$$f\left(\frac{3}{2}\right)=2\left(\frac{3}{2}\right)^2-6\left(\frac{3}{2}\right)+1$$
$$f\left(\frac{3}{2}\right)=2\left(\frac{9}{4}\right)-9+1=$$
$$=\frac{9}{2}-8=-\frac{7}{2}.$$

The vertex is $\left(\frac{3}{2},-\frac{7}{2}\right)$. The vertical line $x=\frac{3}{2}$ is the axis of symmetry.

Next, we choose some x-values on each side of the vertex and compute the y-values.

When $x=0$, $y=2(0)^2-6(0)+1=1$

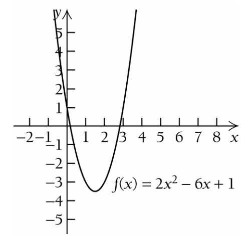
When $x=1$, $y=2(1)^2-6(1)+1=-3$

When $x=2$, $y=2(2)^2-6(2)+1=-3$

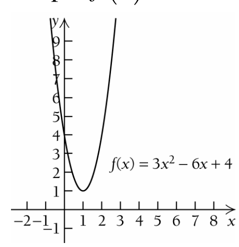
When $x=3$, $y=2(3)^2-6(3)+1=1$

x	y
0	1
1	-3
$\frac{3}{2}$	$-\frac{7}{2}$
2	-3
3	1

We plot these points and connect them with a smooth curve on the axis below.



22. Graph $f(x)=3x^2-6x+4$.



23. Graph $g(x)=-3x^2-4x+5$.

First, we should recognize that this function is a quadratic function. We find the vertex or the turning point. The x-coordinate of the vertex is

$$x=-\frac{b}{2a}=-\frac{-4}{2(-3)}=-\frac{2}{3}$$

Substituting $-2/3$ for x into the equation, we find the second coordinate of the vertex:

$$f\left(-\frac{2}{3}\right)=-3\left(-\frac{2}{3}\right)^2-4\left(-\frac{2}{3}\right)+5$$
$$=-3\left(\frac{4}{9}\right)+\frac{8}{3}+5=$$
$$=-\frac{4}{3}+\frac{8}{3}+5=\frac{19}{3}.$$

The vertex is $\left(-\frac{2}{3},\frac{19}{3}\right)$. The vertical line $x=-\frac{2}{3}$ is the axis of symmetry. Next, we choose some x-values on each side of the vertex and compute the y-values.

When $x=-2, y=-3(-2)^2-4(-2)+5=1$

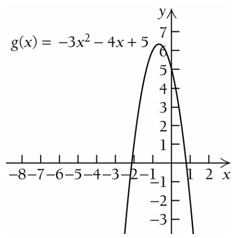
When $x=-1, y=-3(-1)^2-4(-1)+5=6$

When $x=0, y=-3(0)^2-4(0)+5=5$

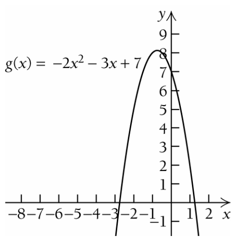
When $x=1, y=-3(1)^2-4(1)+5=-2$

x	y
–2	1
–1	6
$-\frac{2}{3}$	$\frac{19}{3}$
0	5
1	–2

We plot these points and connect them with a smooth curve on the axis below.



24. Graph $g(x)=-2x^2-3x+7$.



25. Graph $y=\dfrac{2}{x}$.

First we determine the domain. The domain is all real numbers except for 0, since substituting 0 for x would result in division by 0. Now, to find y-values, we substitute any value for x other than 0, and compute the value for y.

When $x=-4,\ y=\dfrac{2}{-4}=-\dfrac{1}{2}$

When $x=-2,\ y=\dfrac{2}{-2}=-1$

When $x=-1,\ y=\dfrac{2}{-1}=-2$

When $x=\ 1,\ y=\dfrac{2}{1}=2$

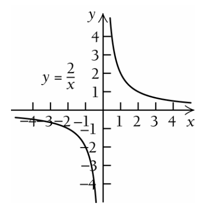
When $x=\ 2,\ y=\dfrac{2}{2}=1$

When $x=\ 4,\ y=\dfrac{2}{4}=\dfrac{1}{2}$

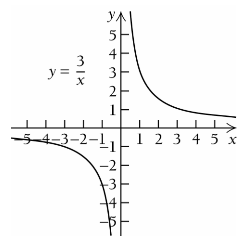
We create an input-output table at the top of the next column.

x	y
–4	$-\frac{1}{2}$
–2	–1
–1	–2
1	2
2	1
4	$\frac{1}{2}$

We plot these points and connect them with a smooth curve on the axis below.



26. Graph $y=\dfrac{3}{x}$.



27. Graph $y=-\dfrac{2}{x}$.

First we determine the domain. The domain is all real numbers except for 0, since substituting 0 for x would result in division by 0. Now, to find y-values, we substitute any value for x other than 0, and compute the value for y.

When $x=-4,\ y=-\dfrac{2}{-4}=\dfrac{1}{2}$

When $x=-2,\ y=-\dfrac{2}{-2}=1$

When $x=-1,\ y=-\dfrac{2}{-1}=2$

When $x=\ 1,\ y=-\dfrac{2}{1}=-2$

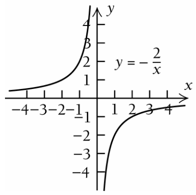
When $x=\ 2,\ y=-\dfrac{2}{2}=-1$

When $x=\ 4,\ y=-\dfrac{2}{4}=-\dfrac{1}{2}$

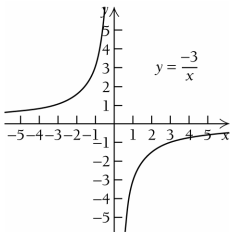
We create an input output table on the next page.

x	y
-4	$\frac{1}{2}$
-2	1
-1	2
1	-2
2	-1
4	$-\frac{1}{2}$

We plot these points and connect them with a smooth curve on the axis below.



28. Graph $y=-\dfrac{3}{x}$.



29. Graph $y=\dfrac{1}{x^2}$.

First we determine the domain. The domain is all real numbers except for 0, since substituting 0 for x would result in division by 0. Now, to find y-values, we substitute any value for x other than 0, and compute the value for y.

When $x=-2,\ y=\dfrac{1}{(-2)^2}=\dfrac{1}{4}$

When $x=-1,\ y=\dfrac{1}{(-1)^2}=1$

When $x=-\dfrac{1}{2},\ y=\dfrac{1}{\left(-\frac{1}{2}\right)^2}=\dfrac{1}{\frac{1}{4}}=4$

When $x=\ \dfrac{1}{2},\ y=\dfrac{1}{\left(\frac{1}{2}\right)^2}=\dfrac{1}{\frac{1}{4}}=4$

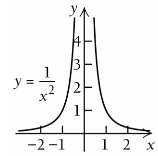
When $x=1,\ y=\dfrac{1}{(1)^2}=1$

When $x=\ 2,\ y=\dfrac{1}{(2)^2}=4$

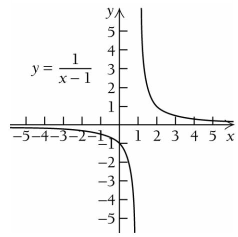
We create an input-output table at the top of the next column.

x	y
-2	$\frac{1}{4}$
-1	1
$-\frac{1}{2}$	4
$\frac{1}{2}$	4
1	1
2	$\frac{1}{4}$

We plot these points and connect them with a smooth curve on the axis below.



30. Graph $y=\dfrac{1}{x-1}$.



31. Graph $y=\sqrt[3]{x}$.

First we determine the domain of the function. Since the index of the radicand is odd (3) the domain is all real numbers. We are free to choose any number for x and compute the value for y.

When $x=-8,\ y=\sqrt[3]{-8}=-2$

When $x=-1,\ y=\sqrt[3]{-1}=-1$

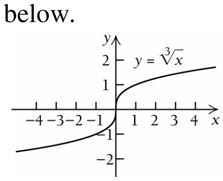
When $x=\ 0,\ y=\sqrt[3]{0}=0$

When $x=\ 1,\ y=\sqrt[3]{1}=1$

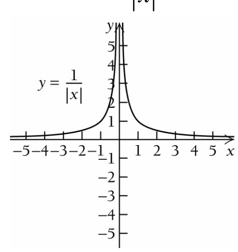
When $x=\ 8,\ y=\sqrt[3]{8}=2$

x	y
-8	-2
-1	-1
0	0
1	1
8	2

We plot these points and connect them with a smooth curve on the axis below.



32. Graph $y=\dfrac{1}{|x|}$.



33. Graph $f\left(x\right)=\dfrac{x^2+5x+6}{x+3}$.

First, we simplify the function, by factoring the numerator and removing a factor of 1 as follows:

$$\begin{aligned}f\left(x\right)&=\frac{x^2+5x+6}{x+3}\\&=\frac{\left(x+3\right)\left(x+2\right)}{x+3}\\f\left(x\right)&=\frac{x+3}{x+3}\cdot\frac{x+2}{1}\\&=x+2,\quad x\neq-3\end{aligned}$$

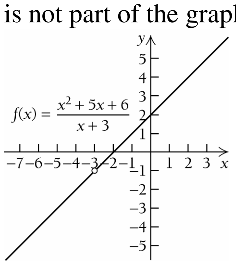
The simplification assumes that x is not -3. The number -3 is not in the domain of the original function because it would result in division by zero. Thus we can express the function as follows:

$y=f\left(x\right)=x+2,\quad x\neq-3.$

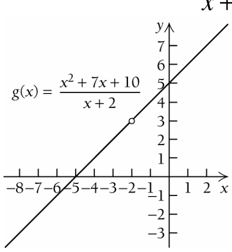
To find function values, we substitute any value for x other than -3 and calculate the y-values.

x	y
–5	–3
–4	–2
–2	0
–1	1
0	2
1	3
2	4

We plot these points and draw the graph. The open circle at the point $\left(-3,-1\right)$ indicates that it is not part of the graph.



34. Graph $g\left(x\right)=\dfrac{x^2+7x+10}{x+2}$.



35. Graph $f\left(x\right)=\dfrac{x^2-1}{x-1}$.

First, we simplify the function, by factoring the numerator and removing a factor of 1 as follows:

$$\begin{aligned}f\left(x\right)&=\frac{x^2-1}{x-1}\\&=\frac{\left(x-1\right)\left(x+1\right)}{x-1}\\f\left(x\right)&=\frac{x-1}{x-1}\cdot\frac{x+1}{1}\\&=x+1,\quad x\neq1\end{aligned}$$

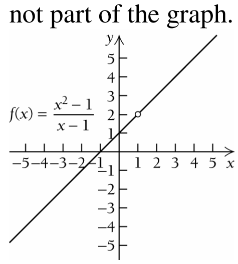
The simplification assumes that x is not 1. The number 1 is not in the domain of the original function because it would result in division by zero. Thus we can express the function as follows:

$y=f\left(x\right)=x+1,\quad x\neq1.$

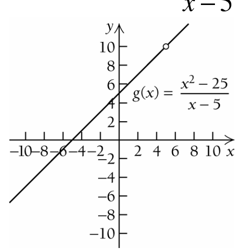
To find function values, we substitute any value for x other than 1 and calculate the y-values.

x	y
–2	–1
–1	0
0	1
2	3
3	4
4	5

We plot these points and draw the graph. The open circle at the point $\left(1,2\right)$ indicates that it is not part of the graph.



36. Graph $g\left(x\right)=\dfrac{x^2-25}{x-5}$.



37. Solve $x^2 - 2x = 2$.
First, we put the equation in standard form.
$x^2 - 2x - 2 = 0$ subtract 2 from both sides
The equation is in standard form with
$a = 1,\ b = -2,\ c = -2$
Next, we apply the quadratic formula.
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
Substituting the values for *a, b,* and *c*, we get:
$$x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(1)(-2)}}{2(1)}$$
$$= \frac{2 \pm \sqrt{4+8}}{2} = \frac{2 \pm \sqrt{12}}{2}$$
$$= \frac{2 \pm 2\sqrt{3}}{2} \qquad \left(\sqrt{12} = \sqrt{4 \cdot 3} = 2\sqrt{3}\right)$$
$$= \frac{2\left(1 \pm \sqrt{3}\right)}{2 \cdot 1} = 1 \pm \sqrt{3}$$
The solutions are $1 + \sqrt{3}$ and $1 - \sqrt{3}$.

38. Solve $x^2 - 2x + 1 = 5$.
First, we put the equation into standard form.
$x^2 - 2x - 4 = 0$
Next we apply the quadratic formula.
$$x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(1)(-4)}}{2(1)}$$
$$= \frac{2 \pm \sqrt{4+16}}{2} = \frac{2 \pm \sqrt{20}}{2} = \frac{2 \pm 2\sqrt{5}}{2}$$
$$= \frac{2\left(1 \pm \sqrt{5}\right)}{2} = 1 \pm \sqrt{5}$$
The solutions are $1 + \sqrt{5}$ and $1 - \sqrt{5}$.

39. Solve $x^2 + 6x = 1$.
First, we put the equation in standard form.
$x^2 + 6x - 1 = 0$ subtract 1 from both sides
The equation is in standard form with
$a = 1,\ b = 6,\ c = -1$
Next, we apply the quadratic formula.
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
Substituting the values for *a, b,* and *c*, we get:
$$x = \frac{-(6) \pm \sqrt{(6)^2 - 4(1)(-1)}}{2(1)}$$
$$= \frac{-6 \pm \sqrt{36+4}}{2} = \frac{-6 \pm \sqrt{40}}{2}$$
$$= \frac{-6 \pm 2\sqrt{10}}{2} \qquad \left(\sqrt{40} = \sqrt{4 \cdot 10} = 2\sqrt{10}\right)$$
$$= \frac{2\left(-3 \pm \sqrt{10}\right)}{2 \cdot 1} = -3 \pm \sqrt{10}$$
The solutions are $-3 + \sqrt{10}$ and $-3 - \sqrt{10}$.

40. Solve $x^2 + 4x = 3$.
First, we put the equation into standard form.
$x^2 + 4x - 3 = 0$
Next we apply the quadratic formula.
$$x = \frac{-(4) \pm \sqrt{(4)^2 - 4(1)(-3)}}{2(1)}$$
$$= \frac{-4 \pm \sqrt{16+12}}{2} = \frac{-4 \pm \sqrt{28}}{2} = \frac{-4 \pm 2\sqrt{7}}{2}$$
$$= \frac{2\left(-2 \pm \sqrt{7}\right)}{2} = -2 \pm \sqrt{7}$$
The solutions are $-2 + \sqrt{7}$ and $-2 - \sqrt{7}$.

41. Solve $4x^2 = 4x + 1$.
First, we put the equation in standard form.
$4x^2 - 4x - 1 = 0$ subtract $4x$ and 1 from both sides
The equation is in standard form with
$a = 4,\ b = -4,\ c = -1$
Next, we apply the quadratic formula.
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
Substituting the values for *a, b,* and *c*, we get:
$$x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(4)(-1)}}{2(4)}$$
$$= \frac{4 \pm \sqrt{16+16}}{8}$$
$$= \frac{4 \pm \sqrt{32}}{8}$$
$$x = \frac{4 \pm 4\sqrt{2}}{8} \qquad \left(\sqrt{32} = \sqrt{16 \cdot 2} = 4\sqrt{2}\right)$$
$$= \frac{4\left(1 \pm \sqrt{2}\right)}{4 \cdot 2} = \frac{1 \pm \sqrt{2}}{2}$$
The solutions are $\frac{1+\sqrt{2}}{2}$ and $\frac{1-\sqrt{2}}{2}$.

42. Solve $-4x^2 = 4x - 1$.

First, we put the equation into standard form.

$4x^2 + 4x - 1 = 0$

Next we apply the quadratic formula.

$$x = \frac{-(4) \pm \sqrt{(4)^2 - 4(4)(-1)}}{2(4)}$$
$$= \frac{-4 \pm \sqrt{16+16}}{8} = \frac{-4 \pm \sqrt{32}}{8} = \frac{-4 \pm 4\sqrt{2}}{8}$$
$$= \frac{4(-1 \pm \sqrt{2})}{2 \cdot 4} = \frac{-1 \pm \sqrt{2}}{2}$$

The solutions are $\frac{-1+\sqrt{2}}{2}$ and $\frac{-1-\sqrt{2}}{2}$.

43. Solve $3y^2 + 8y + 2 = 0$.

The equation is in standard form with $a = 3,\ b = 8,\ c = 2$

Next, we apply the quadratic formula.

$$y = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Substituting the values for *a, b,* and *c*, we get:

$$y = \frac{-(8) \pm \sqrt{(8)^2 - 4(3)(2)}}{2(3)}$$
$$= \frac{-8 \pm \sqrt{64-24}}{6} = \frac{-8 \pm \sqrt{40}}{6}$$
$$= \frac{-8 \pm 2\sqrt{10}}{6} \qquad \left(\sqrt{40} = \sqrt{4 \cdot 10} = 2\sqrt{10}\right)$$
$$= \frac{2(-4 \pm \sqrt{10})}{2 \cdot 3} = \frac{-4 \pm \sqrt{10}}{3}$$

The solutions are $\frac{-4+\sqrt{10}}{3}$ and $\frac{-4-\sqrt{10}}{3}$.

44. Solve $2p^2 - 5p = 1$.

First, we put the equation into standard form.

$2p^2 - 5p - 1 = 0$

Next we apply the quadratic formula.

$$p = \frac{-(-5) \pm \sqrt{(-5)^2 - 4(2)(-1)}}{2(2)}$$
$$= \frac{5 \pm \sqrt{25+8}}{4} = \frac{5 \pm \sqrt{33}}{4}$$

The solutions are $\frac{5+\sqrt{33}}{4}$ and $\frac{5-\sqrt{33}}{4}$.

45. Solve $x + 7 + \frac{9}{x} = 0$.

Multiplying both sides by *x*, we get:

$$x \cdot \left(x + 7 + \frac{9}{x}\right) = 0 \cdot x$$
$$x^2 + 7x + 9 = 0.$$

This is a quadratic equation in standard form with $a = 1, b = 7,$ and $c = 9$.

Next, we apply the quadratic formula.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Substituting the values for *a, b,* and *c*, we get:

$$x = \frac{-(7) \pm \sqrt{(7)^2 - 4(1)(9)}}{2(1)}$$
$$= \frac{-7 \pm \sqrt{49-36}}{2} = \frac{-7 \pm \sqrt{13}}{2}$$

The solutions are $\frac{-7+\sqrt{13}}{2}$ and $\frac{-7-\sqrt{13}}{2}$.

46. Solve $1 - \frac{1}{w} = \frac{1}{w^2}$.

Multiplying both sides by w^2 we get:

$$w^2\left(1 - \frac{1}{w}\right) = \frac{1}{w^2} \cdot w^2$$
$$w^2 - w = 1$$
$$w^2 - w - 1 = 0$$

This is a quadratic equation in standard form.
Next, we apply the quadratic formula.

$$w = \frac{-(-1) \pm \sqrt{(-1)^2 - 4(1)(-1)}}{2(1)}$$
$$= \frac{1 \pm \sqrt{1+4}}{2} = \frac{1 \pm \sqrt{5}}{2}$$

The solutions are $\frac{1+\sqrt{5}}{2}$ and $\frac{1-\sqrt{5}}{2}$.

47. $\sqrt{x^3} = x^{3/2}$ $\quad\left(\text{The index is 2; } \sqrt[n]{a^m} = a^{m/n}\right)$

48. $\sqrt{x^5} = x^{5/2}$

49. $\sqrt[5]{a^3} = a^{3/5}$ $\quad\left(\sqrt[n]{a^m} = a^{m/n}\right)$

50. $\sqrt[4]{b^2} = b^{2/4} = b^{1/2}$

51. $\sqrt[7]{t} = t^{1/7}$

52. $\sqrt[8]{c} = c^{1/8}$

53. $\sqrt[4]{x^{12}} = x^{12/4} = x^3$

54. $\sqrt[3]{t^6} = t^{6/3} = t^2$

55. $\dfrac{1}{\sqrt{t^5}} = \dfrac{1}{t^{5/2}} \qquad \left(\sqrt[n]{a^m} = a^{m/n}\right)$

$= t^{-5/2} \qquad \left(\dfrac{1}{a^n} = a^{-n}\right)$

56. $\dfrac{1}{\sqrt{m^4}} = \dfrac{1}{m^{4/2}} = \dfrac{1}{m^2} = m^{-2}$

57. $\dfrac{1}{\sqrt{x^2+7}} = \dfrac{1}{\left(x^2+7\right)^{1/2}} \qquad \left(\sqrt[n]{a^m} = a^{m/n}\right)$

$= \left(x^2+7\right)^{-1/2} \qquad \left(\dfrac{1}{a^n} = a^{-n}\right)$

58. $\sqrt{x^3+4} = \left(x^3+4\right)^{1/2}$

59. $x^{1/5} = \sqrt[5]{x^1} = \sqrt[5]{x} \qquad \left(a^{m/n} = \sqrt[n]{a^m}\right)$

60. $t^{1/7} = \sqrt[7]{t}$

61. $y^{2/3} = \sqrt[3]{y^2} \qquad \left(a^{m/n} = \sqrt[n]{a^m}\right)$

62. $t^{2/5} = \sqrt[5]{t^2}$

63. $t^{-2/5} = \dfrac{1}{t^{2/5}} \qquad \left(a^{-n} = \dfrac{1}{a^n}\right)$

$= \dfrac{1}{\sqrt[5]{t^2}} \qquad \left(a^{m/n} = \sqrt[n]{a^m}\right)$

64. $y^{-2/3} = \dfrac{1}{y^{2/3}} = \dfrac{1}{\sqrt[3]{y^2}}$

65. $b^{-1/3} = \dfrac{1}{b^{1/3}} \qquad \left(a^{-n} = \dfrac{1}{a^n}\right)$

$= \dfrac{1}{\sqrt[3]{b}} \qquad \left(a^{m/n} = \sqrt[n]{a^m}\right)$

66. $b^{-1/5} = \dfrac{1}{b^{1/5}} = \dfrac{1}{\sqrt[5]{b}}$

67. $e^{-17/6} = \dfrac{1}{e^{17/6}} \qquad \left(a^{-n} = \dfrac{1}{a^n}\right)$

$= \dfrac{1}{\sqrt[6]{e^{17}}} \qquad \left(a^{m/n} = \sqrt[n]{a^m}\right)$

68. $m^{-19/6} = \dfrac{1}{m^{19/6}} = \dfrac{1}{\sqrt[6]{m^{19}}}$

69. $\left(x^2-3\right)^{-1/2} = \dfrac{1}{\left(x^2-3\right)^{1/2}} \qquad \left(a^{-n} = \dfrac{1}{a^n}\right)$

$= \dfrac{1}{\sqrt{x^2-3}} \qquad \left(a^{m/n} = \sqrt[n]{a^m}\right)$

70. $\left(y^2+7\right)^{-1/4} = \dfrac{1}{\left(y^2+7\right)^{1/4}} = \dfrac{1}{\sqrt[4]{y^2+7}}$

71. $\dfrac{1}{t^{2/3}} = \dfrac{1}{\sqrt[3]{t^2}} \qquad \left(a^{m/n} = \sqrt[n]{a^m}\right)$

72. $\dfrac{1}{w^{-4/5}} = w^{4/5} = \sqrt[5]{w^4}$

73. $9^{3/2}$

$= \left(9^{1/2}\right)^3 \qquad \left(\frac{3}{2} = \frac{1}{2}\cdot 3;\ a^{m\cdot n} = \left(a^m\right)^n\right)$

$= \left(\sqrt{9}\right)^3 \qquad \left(a^{1/n} = \sqrt[n]{a}\right)$

$= (3)^3 = 27$

74. $16^{5/2} = \left(16^{1/2}\right)^5 = \left(\sqrt{16}\right)^5 = (4)^5 = 1024$

75. $64^{2/3}$

$= \left(64^{1/3}\right)^2 \qquad \left(\frac{2}{3} = \frac{1}{3}\cdot 2;\ a^{m\cdot n} = \left(a^m\right)^n\right)$

$= \left(\sqrt[3]{64}\right)^2 \qquad \left(a^{1/n} = \sqrt[n]{a}\right)$

$= (4)^2 \qquad \left(\sqrt[3]{64} = 4\right)$

$= 16$

76. $8^{2/3} = \left(8^{1/3}\right)^2 = \left(\sqrt[3]{8}\right)^2 = (2)^2 = 4$

77. $16^{3/4}$

$= \left(16^{1/4}\right)^3 \qquad \left(\frac{3}{4} = \frac{1}{4}\cdot 3;\ a^{m\cdot n} = \left(a^m\right)^n\right)$

$= \left(\sqrt[4]{16}\right)^3 \qquad \left(a^{1/n} = \sqrt[n]{a}\right)$

$= (2)^3 \qquad \left(\sqrt[4]{16} = 2\right)$

$= 8$

78. $25^{5/2} = \left(25^{1/2}\right)^5 = \left(\sqrt{25}\right)^5 = (5)^5 = 3125$

79. The domain of a rational function is restricted to those input values that do not result in division by 0. To determine the domain of

$$f(x) = \frac{x^2 - 25}{x - 5}$$

we set the denominator equal to zero and solve:

$x - 5 = 0$

$x = 5.$

Therefore, 5 is not in the domain. The domain of *f* consists of all real numbers except 5.

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

Solve:

$x + 2 = 0$

$x = -2.$

Therefore, -2 is not in the domain. The domain of *f* consists of all real numbers except -2.

81. The domain of a rational function is restricted to those input values that do not result in division by 0.

To determine the domain of

$$f(x) = \frac{x^3}{x^2 - 5x + 6}$$

we set the denominator equal to zero and solve:

$x^2 - 5x + 6 = 0$

$(x-2)(x-3) = 0$ factoring

$x - 2 = 0$ or $x - 3 = 0$ Principle of Zero Products

$x = 2$ or $x = 3.$

Therefore, 2 and 3 are not in the domain. The domain of *f* consists of all real numbers except 2 and 3.

82. $f(x) = \dfrac{x^4 + 7}{x^2 + 6x + 5}$

Solve:

$x^2 + 6x + 5 = 0$

$(x+5)(x+1) = 0$

$x = -5$ or $x = -1$

Therefore, the numbers -5 and -1 are not in the domain. The domain of *f* consists of all real numbers except -5 and -1.

83. The domain of the radical function $f(x) = \sqrt{5x+4}$ is restricted to those input values that result in the value of the radicand being greater than or equal to 0. In other words, the domain will be the set of real numbers that satisfy the inequality $5x + 4 \geq 0$.

To find the domain, we solve the inequality:

$5x + 4 \geq 0$

$5x \geq -4$

$x \geq -\dfrac{4}{5}$

Therefore, the domain of *f* consists of all real numbers greater than or equal to $-\dfrac{4}{5}$, or in interval notation $\left[-\dfrac{4}{5}, \infty\right)$.

84. $f(x) = \sqrt{2x - 6}$

Solve:

$2x - 6 \geq 0$

$2x \geq 6$

$x \geq 3$

The domain is the set of all real numbers greater than or equal to 3, or in interval notation $[3, \infty)$.

85. The domain of the radical function $f(x)=\sqrt[4]{7-x}$ is restricted to those input values that result in the value of the radicand being greater than or equal to 0. In other words, the domain will be the set of real numbers that satisfy the inequality $7-x \geq 0$.
To find the domain, we solve the inequality:
$$7-x \geq 0$$
$$7 \geq x$$
Therefore, the domain of *f* consists of all real numbers less than or equal to 7, or in interval notation $(-\infty, 7]$.

86. $f(x)=\sqrt[6]{5-x}$
Solve:
$$5-x \geq 0$$
$$5 \geq x$$
Therefore, the domain of *f* consists of all real numbers less than or equal to 5, or in interval notation $(-\infty, 5]$.

87. We set the demand equation equal to the supply equation and solve for *x*.
$$1000-10x = 250+5x$$
$$750 = 15x$$
$$50 = x$$
Thus, the equilibrium price is \$50. To find the equilibrium quantity, we substitute 50 for *x* into either the demand equation or supply equation. We use the demand equation.
$$q = 1000-10(50)$$
$$q = 1000-500$$
$$q = 500$$
The equilibrium quantity is 500 units. The equilibrium point is $(50, 500)$.

88. We set demand equal to supply and solve to find equilibrium price.
$$8800-30x = 7000+15x$$
$$1800 = 45x$$
$$40 = x$$
Substitute into the demand equation to find equilibrium quantity.
$$q = 8800-30(40) = 7600.$$
The equilibrium point is $(40, 7600)$.

89. We set the demand equation equal to the supply equation and solve for *x*.
$$\frac{5}{x} = \frac{x}{5}$$
$$25 = x^2 \quad \text{multiply both sides by } 5x$$
$$\sqrt{25} = \sqrt{x^2} \quad \text{take the square root of both sides}$$
$$\pm 5 = x$$
Since it is not appropriate to have a negative price, the equilibrium price is 5 hundred dollars or \$500. To find the equilibrium quantity, we substitute 5 for *x* into either the demand equation or supply equation. We use the demand equation.
$$q = \frac{5}{(5)} = 1$$
The equilibrium quantity is 1 thousand units or 1000 units. The equilibrium point is $(5, 1)$.

90. We set the demand equation equal to the supply equation and solve for *x*.
$$\frac{4}{x} = \frac{x}{4}$$
$$16 = x^2$$
$$\pm 4 = x$$
Since it is not appropriate to have a negative price, the equilibrium price is 4 hundred dollars or \$400. To find the equilibrium quantity, we substitute 4 for *x* into either the demand equation or supply equation. We use the demand equation.
$$q = \frac{4}{(4)}$$
$$q = 1$$
The equilibrium quantity is 1 thousand units or 1000 units. The equilibrium point is $(4, 1)$.

91. We set the demand equation equal to the supply equation and solve for *x*.
$$(x-3)^2 = x^2+2x+1$$
$$x^2-6x+9 = x^2+2x+1$$
$$-6x+9 = 2x+1 \quad \text{subtracting } x^2 \text{ from both sides}$$
$$8 = 8x$$
$$1 = x$$
The equilibrium price is \$1.

To find the equilibrium quantity, we substitute 1 for x into either the demand equation or supply equation. We use the demand equation.

$$q = (1-3)^2$$
$$= (-2)^2 = 4$$

The equilibrium quantity is 4 hundred units or 400 units. The equilibrium point is $(1,4)$.

92. We set the demand equation equal to the supply equation and solve for x.

$$\begin{aligned} (x-4)^2 &= x^2 + 2x + 6 \\ x^2 - 8x + 16 &= x^2 + 2x + 6 \\ -8x + 16 &= 2x + 1 \\ 10 &= 10x \\ 1 &= x \end{aligned}$$

The equilibrium price is \$1.
To find the equilibrium quantity, we substitute 1 for x into either the demand equation or supply equation. We use the demand equation.

$$q = (1-4)^2$$
$$= (-3)^2 = 9$$

The equilibrium quantity is 9 hundred units or 900 units. The equilibrium point is $(1,9)$.

93. We set the demand equation equal to the supply equation and solve for x.

$$5 - x = \sqrt{x+7} \qquad 0 \le x \le 5$$
$$(5-x)^2 = \left(\sqrt{x+7}\right)^2 \quad \text{Squaring both sides}$$
$$25 - 10x + x^2 = x + 7$$
$$18 - 11x + x^2 = 0$$
$$(9-x)(2-x) = 0 \qquad \text{Factoring the quadratic}$$
$$9 - x = 0 \text{ or } 2 - x = 0 \quad \text{Principle of Zero Products}$$
$$9 = x \text{ or } 2 = x$$

Since 9 is not in the domain of the demand function, the equilibrium price is 2 thousand dollars or \$2000. To find the equilibrium quantity, we substitute 2 for x into either the demand equation or supply equation. We use the demand equation.

$$q = 5 - (2) = 3$$

The equilibrium quantity is 3 thousand units or 3000 units. The equilibrium point is $(2,3)$.

94. We set the demand equation equal to the supply equation and solve for x.

$$7 - x = 2\sqrt{x+1} \qquad 0 \le x \le 7$$
$$(7-x)^2 = \left(2\sqrt{x+1}\right)^2$$
$$49 - 14x + x^2 = 4x + 4$$
$$45 - 18x + x^2 = 0$$
$$15 - x = 0 \text{ or } 3 - x = 0$$
$$15 = x \text{ or } 3 = x$$

Since 15 is not in the domain of the demand function, the equilibrium price is 3 thousand dollars or \$3000. To find the equilibrium quantity, we substitute 3 for x into either the demand equation or supply equation. We use the demand equation. $q = 7 - (3) = 4$

The equilibrium quantity is 4 thousand units or 4000 units. The equilibrium point is $(3,4)$.

95. If the price per share S is inversely proportional to the prime rate R, then we have:

$$S = \frac{k}{R}.$$

We find the constant of variation by substituting 86.89 for S and 0.0675 (6.75%) for R.

$$86.89 = \frac{k}{0.0675}$$
$$5.865075 = k$$

The equation of variation is $S = \dfrac{5.865075}{R}$.

If the prime rate rose to 7.50% we find S by substituting 0.075 in for R.

$$S = \frac{5.865075}{0.075}$$
$$= 78.201$$
$$\approx 78.20$$

The price per share would be approximately \$78.20 if the assumption of inverse proportionality is correct.

96. $x = \dfrac{k}{p}$

Find the constant of variation by making the following substitutions.

$$85{,}000 = \frac{k}{2900}$$
$$246{,}500{,}000 = k$$

Therefore, the equation of variation is:

$$x = \frac{246{,}500{,}000}{p}.$$

If the price drops to \$850, then

$$x = \frac{246,500,000}{850} = 290,000$$

290,000 plasma TVs will be sold if the price is \$850.

97. a) $R(x) = 11.74x^{0.25}$

$$\begin{aligned} R(40,000) &= 11.74(40,000)^{0.25} \\ &= 11.74(14.14213562) \\ &= 166.0286722 \\ &\approx 166 \end{aligned}$$

The maximum range will be approximately 166 miles when the peak power is 40,000 watts.

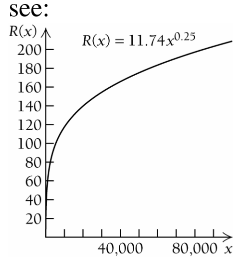
$$\begin{aligned} R(50,000) &= 11.74(50,000)^{0.25} \\ &= 11.74(14.95348781) \\ &= 175.5539469 \\ &\approx 176 \end{aligned}$$

The maximum range will be approximately 176 miles when the peak power is 50,000 watts.

$$\begin{aligned} R(60,000) &= 11.74(60,000)^{0.25} \\ &= 11.74(15.6508458) \\ &= 183.7409297 \\ &\approx 184 \end{aligned}$$

The maximum range will be approximately 184 miles when the peak power is 60,000 watts.

b) Plotting the points found in part (a) and connecting them with a smooth curve we see:

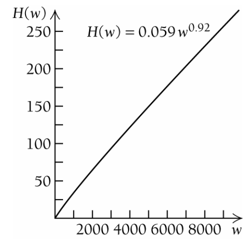


98. Substituting each value given for w in $H(w) = 0.059w^{0.92}$ and using a calculator to compute the values for H we have the following table where the values for H are rounded off to one decimal.

w	0	1000	2000	3000
$H(w)$	0	34.0	64.2	93.3

w	4000	5000	6000	7000
$H(w)$	121.5	149.2	176.5	203.4

We plot the points in the table and graph the function.



99. a) In 2005, $t = 2005 - 1970 = 35$.

$$P = 1000(35)^{5/4} + 14,000 \approx 99,130$$

In 2005, average pollution was approximately 99,130 particles per cubic centimeter.

In 2008, $t = 2008 - 1970 = 38$.

$$P = 1000(38)^{5/4} + 14,000 \approx 108,347$$

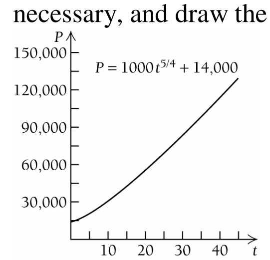
In 2008, average pollution will be approximately 108,347 particles per cubic centimeter.

In 2014, $t = 2014 - 1970 = 44$.

$$P = 1000(44)^{5/4} + 14,000 \approx 127,322$$

In 2014, average pollution will be approximately 127,322 particles per cubic centimeter.

b) Plot the points above and others, if necessary, and draw the graph.



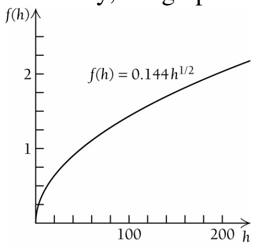
100. a) $f(180) = 0.144(180)^{1/2} \approx 1.93$

The surface area of a person whose mass is 75 kg and height is 180 cm is approximately $1.94m^2$.

b) $f(170) = 0.144(170)^{1/2} \approx 1.88$

The surface area of a person whose mass is 75 kg and height is 170 cm is approximately $1.88m^2$.

c) Plotting the points above and others, if necessary, the graph is:



101. The number of cities N with a population greater than S is inversely proportional to S.

$$N = \frac{k}{S}$$

$$51 = \frac{k}{350{,}000} \quad \text{Substituting}$$

$$17{,}850{,}000 = k$$

The equation of variation is

$$N = \frac{17{,}850{,}000}{S}.$$

We find N when S is 500,000.

$$N = \frac{17{,}850{,}000}{500{,}000} = 35.7 \approx 36$$

Using the fact that there were 51 cities with a population greater than 350,000 and 36 cities with a population of 500,000 or greater, we estimate that there are $51 - 36 = 15$ cities with a population between 350,000 and 500,000.

To estimate the number of cities with a population between 300,000 and 600,000 we find N when S is 300,000 and when S is 600,000.

$$N = \frac{17{,}850{,}000}{300{,}000} = 59.5 \approx 60$$

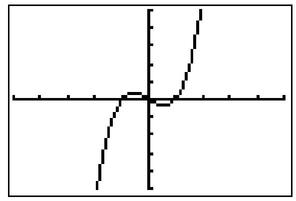
$$N = \frac{17{,}850{,}000}{600{,}000} = 29.75 \approx 30$$

There are 60 cities with a population greater than 300,000 and 30 cities with a population greater than 600,000, so there are $60 - 30 = 30$ cities with a population between 300,000 and 600,000.

102. $\boxed{tw}$ Answers will vary. A function has at most one y-intercept. If a graph has more than one y-intercept, then the vertical line $x = 0$ intersect the graph in more than one point. Thus, the graph fails the vertical line test, and the graph does not represent a function.

103. $\boxed{tw}$ Answers will vary. A rational function is the quotient of two polynomial functions. Every polynomial function can be expressed as a rational function with a denominator of 1, so every polynomial function is a rational function. However, most rational functions are not polynomial functions.

104. We graph $f(x) = x^3 - x$ on our calculator.



Using the ZERO feature we find the 3 zeros are -1, 0, 1.

Algebraically we find the zeros by solving the equation:

$$x^3 - x = 0$$

$$x(x^2 - 1) = 0$$

$$x(x-1)(x+1) = 0$$

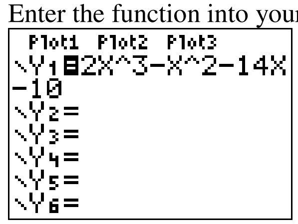
$$x = 0 \text{ or } x - 1 = 0 \text{ or } x + 1 = 0$$

$$x = 0 \text{ or } \quad x = 1 \text{ or } \quad x = -1$$

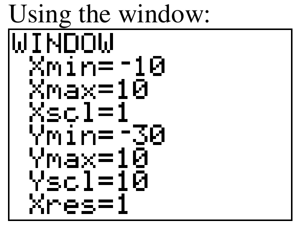
The zeros are -1, 0, 1.

105. $f(x) = 2x^3 - x^2 - 14x - 10$

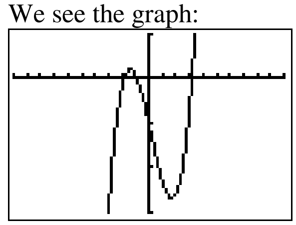
Enter the function into your calculator.



Using the window:



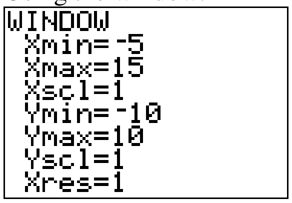
We see the graph:



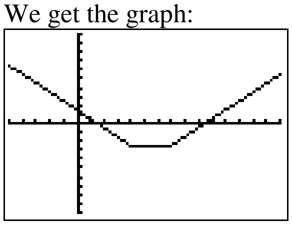
Now using the ZERO feature on the calculator, we approximate the zeros. The zeros are -1.831, -0.856, 3.188.

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

Using the window:



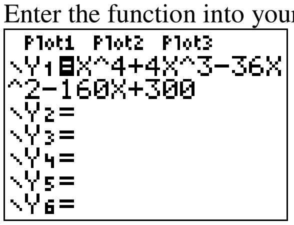
We get the graph:



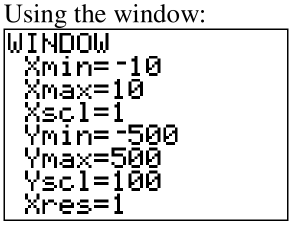
The zeros are 1.5 and 9.5.

107. $f(x)=x^4+4x^3-36x^2-160x+300$

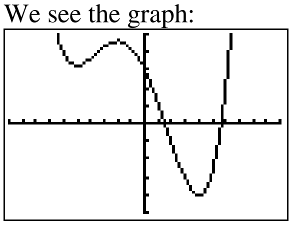
Enter the function into your calculator.



Using the window:



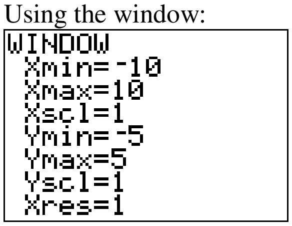
We see the graph:



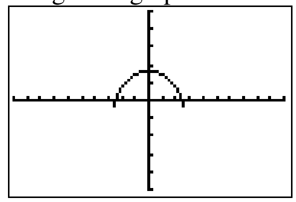
Now using the ZERO feature on the calculator, we approximate the zeros. The zeros are 1.489 and 5.673.

108. $f(x)=\sqrt{7-x^2}-1$

Using the window:



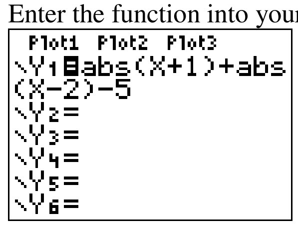
We get the graph:



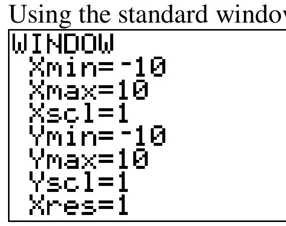
The zeros are -2.449 and 2.449.

109. $f(x)=|x+1|+|x-2|-5$

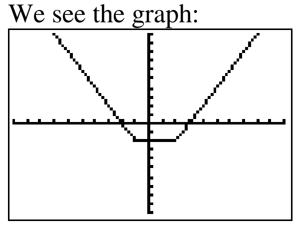
Enter the function into your calculator.



Using the standard window:



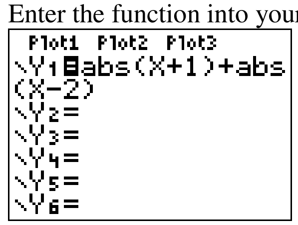
We see the graph:



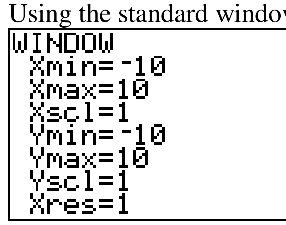
Now using the ZERO feature on the calculator, we approximate the zeros. The zeros are –2 and 3.

110. $f(x)=|x+1|+|x-2|$

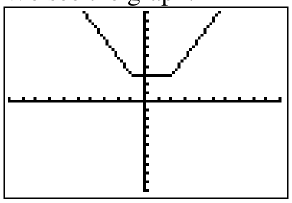
Enter the function into your calculator.



Using the standard window:



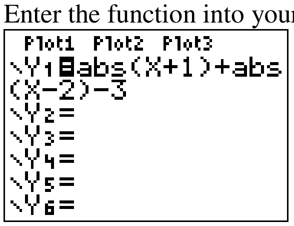
We see the graph:



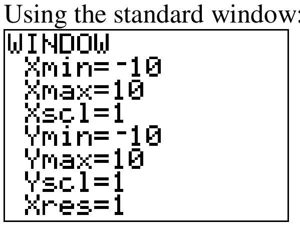
We see that the graph does not cross the x-axis, there are no real zeros.

111. $f(x)=|x+1|+|x-2|-3$

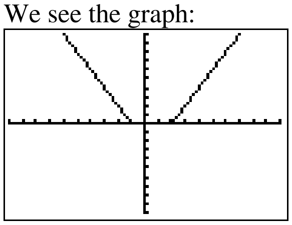
Enter the function into your calculator.



Using the standard window:



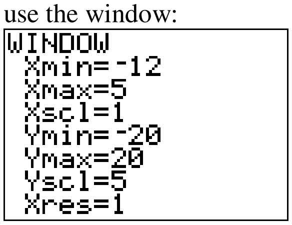
We see the graph:



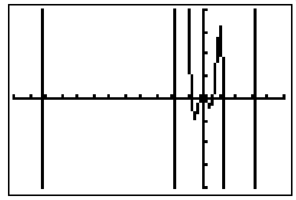
We see that the graph intersects the x-axis between $-1 \le x \le 2$. The zeros of this function are all real numbers in $[-1,2]$

112. $f(x)=x^8+8x^7-28x^6-56x^5+70x^4+56x^3$
$-28x^2-8x+1$

It is difficult to choose a window that shows the entire graph and all of the function's zeros. We use the window:

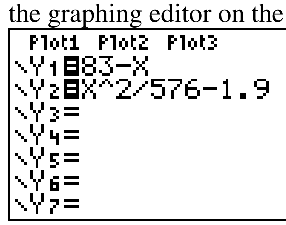


This results in the following graph:

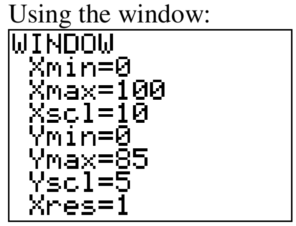


You can see that it difficult to see all of the zeros. It is recommended to zoom in around each zero and then use the ZERO feature to approximate each zero. The zeros are: –10.153, –1.871, –0.821, –0.303, 0.098, 0.535, 1.219, and 3.297.

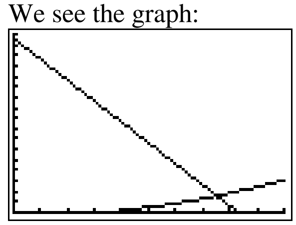
113. We enter the demand and supply equations into the graphing editor on the calculator.



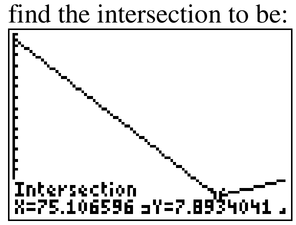
Using the window:



We see the graph:



Using the intersect feature on the calculator we find the intersection to be:



The equilibrium point for this market is $(75.11, 7.893)$. In other words, 7893 units will be sold at a price of \$75.11.

Exercise Set R.6

1. The data is decreasing at a constant rate, so a linear function $f(x)=mx+b$ could be used to model the data.

2. The data falls first and then rises over the domain, so a quadratic function $f(x)=ax^2+bx+c,\ a>0$ could be used to model the data.

3. The data rises first and then falls over the domain, so a quadratic function $f(x)=ax^2+bx+c,\ a<0$ could be used to model the data.

4. The data rises and falls several times over the domain. This implies that a polynomial function that is neither quadratic nor linear would be best to model the data.

5. The data is increasing at a constant rate, so a linear function $f(x)=mx+b$ could be used to model the data.

6. The data rises first and then falls over the domain, so a quadratic function $f(x)=ax^2+bx+c,\ a<0$ could be used to model the data.

7. The data rises and falls several times over the domain. This implies that a polynomial function that is neither quadratic nor linear would be best to model the data.

8. The data rises first and then falls over the domain, so a quadratic function $f(x)=ax^2+bx+c,\ a<0$ could be used to model the data.

9. The data is increasing at a constant rate, so a linear function $f(x)=mx+b$ could be used to model the data.

10. a) We find the linear function $f(x)=mx+b$ that contains the data points $(1,5.25)$ and $(12,7.0)$.

We find the slope containing these two points first.

$$m=\frac{7.0-5.25}{12-1}=\frac{1.75}{11}=\frac{7}{44}$$

Next, we use the slope and one of the points and substitute into the point-slope equation to find the equation of the line.

$$y-y_1=m(x-x_1)$$
$$y-7=\frac{7}{44}(x-12)$$
$$y-7=\frac{7}{44}x-\frac{21}{11}$$
$$y=\frac{7}{44}x+\frac{56}{11}$$

The linear function that models the data is:

$$f(x)=\frac{7}{44}x+\frac{56}{11}$$

Alternatively, we substitute in to the equation $y=mx+b$ to obtain a system of equations.

$$5.25=m\cdot 1+b \qquad (1)$$
$$7.0=m\cdot 12+b \qquad (2)$$

Subtracting each side of Equation (1) from each side of Equation (2) we get:

$$1.75=11m$$
$$\frac{7}{44}=m$$

Now substitute $m=\frac{7}{44}$ in for either Equation (1) or (2) and solve for *b*. We use Equation (1).

$$5.25=\left(\frac{7}{44}\right)(1)+b$$
$$5.25=\frac{7}{44}+b$$
$$\frac{56}{11}=b$$

Therefore, the linear function that fits the data is $y=\frac{7}{44}x+\frac{56}{11}$

b) In June of 2005, $x=6$.

$$f(6)=\frac{7}{44}(6)+\frac{56}{11}\approx 6.05$$

The prime rate in June of 2005 is approximately 6.05%.

11. a) We will choose the points $(0,13)$ and $(4,21)$. First, we find the slope:

$$m=\frac{21-13}{4-0}=\frac{8}{4}=2$$

Next, since we chose the y-intercept, we can substitute into the slope-intercept equation.

$$y=mx+b$$
$$y=2x+13$$

Alternatively, we could have substituted the data points in to the equation $y=mx+b$ to obtain a system of equations.

$$13=m\cdot 0+b \qquad (1)$$
$$21=m\cdot 4+b \qquad (2)$$

Subtracting each side of Equation (1) from each side of Equation (2) we get:

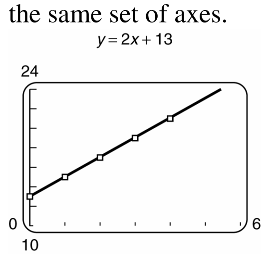
$$8=4m$$
$$2=m$$

Now substitute $m=2$ in for either Equation (1) or (2) and solve for b. We use Equation (1).

$$13=(2)(0)+b$$
$$13=b$$

Therefore, the linear function that fits the data is $y=2x+13$

b) We plot the points in the table in the text and then graph the function found in part (a) on the same set of axes.



c) In 2010, $x=2010-2000=10$
Substituting 10 for x we have:

$$y=2(10)+13=33$$

The average co-payment for preferred drugs in 2010 will be approximately $33.

12. a) Consider the general quadratic function $y=ax^2+bx+c$
Using the points $(0,0),(2,200)$, and $(3,167)$, we substitute each point into the general quadratic function to get the system of equations at the top of the next column.

$$0=a\cdot 0^2+b\cdot 0+c$$
$$200=a\cdot 2^2+b\cdot 2+c$$
$$167=a\cdot 3^2+b\cdot 3+c$$

Which gives us:

$$0=c$$
$$200=4a+2b+c$$
$$167=9a+3b+c$$

From the first equation we see that $c=0$. We substitute this value for c into the other two equations and our system is reduced to:

$$200=4a+2b$$
$$167=9a+3b$$

Solving this system of equations, we get:

$$a=-\frac{133}{3},b=\frac{566}{3},c=0$$

This gives us the quadratic function:

$$f(x)=-\frac{133}{3}x^2+\frac{566}{3}x+0$$
$$=-\frac{133}{3}x^2+\frac{566}{3}x$$

Writing the equation with proper fractions we have:

$$f(x)=-44\tfrac{1}{3}x^2+188\tfrac{2}{3}x.$$

b) $f(4)=-44\tfrac{1}{3}(4)^2+188\tfrac{2}{3}(4)\approx 45.3$.
Approximately 45.3 mg of albuterol will be in the bloodstream after 4 hours.

c) $\boxed{tw}$ Answers will vary. It does not make sense to use this function for $t=6$ because albuterol will leave the blood stream entirely after about 4 hours. 6 is not in the domain of this function.

13. a) Consider the general quadratic function $y=ax^2+bx+c$, where y is the braking distance, in feet, and x is the speed, in miles per hour.
Using the points $(20,25),(40,105)$, and $(60,300)$, we substitute each point into the general quadratic function to get the following system of equations:

$$25=a\cdot 20^2+b\cdot 20+c$$
$$105=a\cdot 40^2+b\cdot 40+c$$
$$300=a\cdot 60^2+b\cdot 60+c$$

or,

$$25=400a+20b+c$$
$$105=1600a+40b+c$$
$$300=3600a+60b+c$$

Solving the system of equations on the previous page, we get
$a = 0.14375,\ b = -4.625,$ and $c = 60$.
Therefore, the function is
$y = 0.144x^2 - 4.63x + 60$.

b) We substitute 50 for x and compute the value of y.
$y = 0.144(50)^2 - 4.63(50) + 60 = 188.5$
The breaking distance of a car traveling at 50 mph is about 188.5 ft.

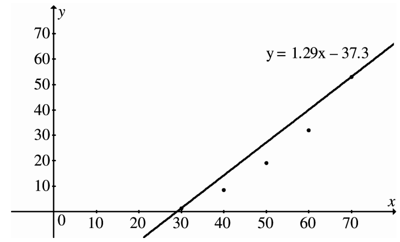
c) $\boxed{tw}$ No, the function does not make sense for speeds less than 15 mph. The vertex of the parabola occurs around 16 mph. Thus for speeds less than 16 mph the breaking distance starts increasing as the speed decreases.

14. a) $N(x) = ax^2 + bx + c$
$100 = a\cdot 60^2 + b\cdot 60 + c$
$130 = a\cdot 80^2 + b\cdot 80 + c$
$200 = a\cdot 100^2 + b\cdot 100 + c$
Solving this system we get:
$a = 0.05, b = -5.5,$ and $c = 250$.
Therefore, the function is:
$N(x) = 0.05x^2 - 5.5x + 250$

b) $N(50) = 0.05(50)^2 - 5.5(50) + 250 = 100$
At 50 km/h, 100 accidents occur per 200 million km driven.

15. a) Answers will vary depending on which points are used to find the function.
We will use the points $(30,1.4)$ and $(70,53.0)$. We substitute in to the equation $y = mx + b$ to obtain a system of equations.
$1.4 = m\cdot 30 + b \quad (1)$
$53.0 = m\cdot 70 + b \quad (2)$
Subtracting each side of Equation (1) from each side of Equation (2) we get:
$51.6 = 40m$
$1.29 = m$
Now substitute $m = 1.29$ in for either Equation (1) or (2) and solve for b. We use Equation (1).
$1.4 = (1.29)(30) + b$
$1.4 = 38.7 + b$
$-37.3 = b$
Therefore, the linear function that fits the data is $y = 1.29x - 37.3$.

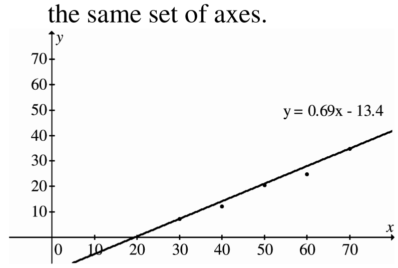
b) We plot the points in the table in the text and then graph the function found in part (a) on the same set of axes.



c) Substituting in 55 for x we have:
$y = 1.29(55) - 37.3 = 33.65$.
Approximately 33.65% of 55-yr-old women have high blood pressure.

16. a) Answers will vary depending on which points are used to find the function.
We will use the points $(30,7.3)$ and $(70,34.9)$. We substitute in to the equation $y = mx + b$ to obtain a system of equations.
$7.3 = m\cdot 30 + b \quad (1)$
$34.9 = m\cdot 70 + b \quad (2)$
Subtracting each side of Equation (1) from each side of Equation (2) we get:
$27.6 = 40m$
$0.69 = m$
Now substitute $m = 0.69$ in for either Equation (1) or (2) and solve for b. We use Equation (1).
$7.3 = (0.69)(30) + b$
$7.3 = 20.7 + b$
$-13.4 = b$
Therefore, the linear function that fits the data is $y = 0.69x - 13.4$.

b) We plot the points in the table in the text and then graph the function found in part (a) on the same set of axes.



c) Substituting in 55 for x we have:
$y = 0.69(55) - 13.4 = 24.55$.
Approximately 24.55% of 55-yr-old men have high blood pressure.

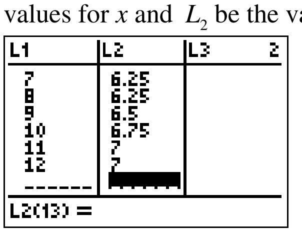
17. $\boxed{tw}$ Answers will vary. With the small amount of data, it is difficult to determine what trend the data is taking on. Since linear functions are easier to find than other polynomial functions, we might want to trade off accuracy for simplicity.

18. $\boxed{tw}$ Answers will vary. During the late spring and early summer, the days grow longer and thus the number of hours of daylight increases. After the summer solstice, the hours of daylight begin to decrease. Since the data values increase then decrease, a quadratic function with $a < 0$ would be appropriate to model the number of hours of daylight for the dates April 22 to August 22.

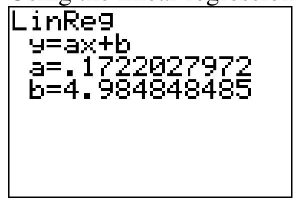
19. $\boxed{tw}$ Answers will vary. Since the data deals with the amount of Albuterol in the bloodstream, the domain should be restricted to nonnegative numbers because the amount of Albuterol in the bloodstream can not be measured until the drug is ingested. The upper restriction on the domain will be the amount of time it takes for Albuterol to exit the system. For the data in Exercise 12, this domain should not extend beyond $[0,4]$.

20. $\boxed{tw}$ Answers will vary. The domain must be restricted to the nonnegative numbers since negative speed have no meaning. A car traveling at 0 miles per hour would have a breaking distance of 0 feet, so 0 could be included in the domain. Realistically, there will also be an upper limit on the domain. The upper limit would be based upon the maximum speed of the automobile.

21. a) First, we enter the data into the statistic editor on the calculator, letting L_1 be the values for x and L_2 be the values for y.



Using the linear regression feature we get:



The linear function that fits the data is $y = 0.172x + 4.98$

b) Substituting 6 in for x we get:

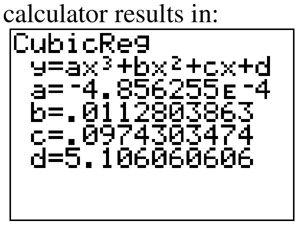
$y = 0.172(6) + 4.98$

$= 6.012$

The prime rate in June 2005 will be approximately 6.012%

c) The actual prime rate in June of 2005 was 6.0%. So the linear regression on the calculator gave us a slightly closer approximation to the actual prime rate for that month. However, they are both very close.

d) Using the cubic regression feature on the calculator results in:



$y = -0.000486x^3 + 0.011x^2 + 0.097x + 5.106$

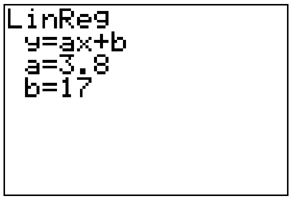
Substituting in 6 for x we get:

$y = -0.000486(6)^3 + .011(6)^2$
$\quad + 0.097(6) + 5.106$
$= 5.98$
≈ 5.98

The cubic function estimated the prime rate to be 5.98% for June of 2005.

e) $\boxed{tw}$ Answers will vary. The linear model is more appropriate for this data even though the cubic model gave us a more accurate approximation. The leading coefficient on the cubic model is approximately -0.0004856. The additional accuracy gained in the cubic model does not justify the amount of effort needed to create and to use the cubic model for calculations. It is best to use the simpler linear model in this case.

22. a) Using the regression feature we get the model:



The regression model is:

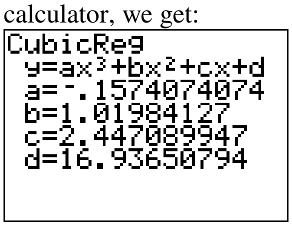
$y = 3.8x + 17$.

b) $y = 3.8(5) + 17 = 36$

$y = 3.8(10) + 17 = 55$

In 2005, the average co-payment is \$36. In 2010, the average co-payment is \$55.

c) Using the cubic regression feature on the calculator, we get:



The cubic regression model is

$$y = -0.1574074074x^3 + 1.01984127x^2 + 2.447089947x + 16.93650794$$

In 2005:

$$y = -0.1574074074(5)^3 + 1.01984127(5)^2 + 2.447089947(5) + 16.93650794$$
$$\approx 34.99$$

The average co-payment was \$34.99.

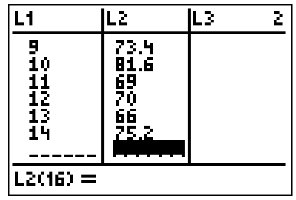
In 2010:

$$y = -0.1574074074(10)^3 + 1.01984127(10)^2 + 2.447089947(10) + 16.93650794$$
$$\approx -14.02$$

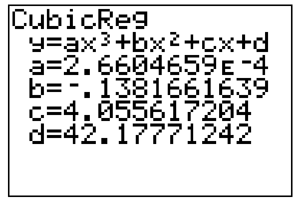
The average co-payment was –\$14.02.

d) $\boxed{tw}$ The linear model is more appropriate for this data set. The cubic model becomes very inaccurate when predicting future co-payments.

23. a) Letting x be the number of years after 1990, we enter the data into the statistics editor of the graphing calculator. We enter the years since 1990 into L_1 and the trade deficit into L_2 .



Next, we use the cubic regression feature on the calculator to fit the data to the model.



The cubic function that fits the data is:

$$y = 0.00027x^3 - 0.1382x^2 + 4.056x + 42.178$$

b) To predict the trade deficit in 2006, we substitute 16 in for x and compute y.

$$y = 0.00027(16)^3 - 0.1382(16)^2 + 4.056(16) + 42.178$$
$$\approx 72.80072$$
$$\approx 72.8$$

The trade deficit in 2006 was approximately 72.8 billion dollars.

To predict the trade deficit in 2010, we substitute 20 in for x and compute y.

$$y = 0.00027(20)^3 - 0.1382(20)^2 + 4.056(20) + 42.178$$
$$\approx 70.178$$
$$\approx 70.2$$

The trade deficit in 2010 will be approximately 70.2 billion dollars.

c) $\boxed{tw}$ Answers will vary. The data appears to be nonlinear, however it does appear to have a linear trend. This means that even though the data increases and decreases, it is doing so along an upward sloping line. Therefore if the fluctuations about the linear trend are not too large, we can fit the data with a linear model and sacrifice a little bit of accuracy for much greater simplicity. Further more, we see that the leading coefficient for the cubic model is very close to zero. This leads us to believe the linear model might be good enough to use.