2.2 Exercises

Perform each of the following tasks for the functions defined by the equations in Exercises 1-8.

i. Set up a table of points that satisfy the given equation. Please place this table of points next to your graph on your graph paper.

ii. Set up a coordinate system on a sheet of graph paper. Label and scale each axis, then plot each of the points from your table on your coordinate system.

iii. If you are confident that you “see” the shape of the graph, make a “leap of faith” and plot all pairs that satisfy the given equation by drawing a smooth curve (free-hand) on your coordinate system that contains all previously plotted points (use a ruler only if the graph of the equation is a line). If you are not confident that you “see” the shape of the graph, then add more points to your table, plot them on your coordinate system, and see if this helps. Continue this process until you “see” the shape of the graph and can fill in the rest of the points that satisfy the equation by drawing a smooth curve (or line) on your coordinate system.

1. \( f(x) = 2x + 1 \)

2. \( f(x) = 1 - x \)

3. \( f(x) = 3 - \frac{1}{2}x \)

4. \( f(x) = -1 + \frac{1}{2}x \)

5. \( f(x) = x^2 - 2 \)

6. \( f(x) = 4 - x^2 \)

7. \( f(x) = \frac{1}{2}x^2 - 6 \)

8. \( f(x) = 8 - \frac{1}{2}x^2 \)

Perform each of the following tasks for the functions Exercises 9-10.

i. Set up a coordinate system on a sheet of graph paper. Label and scale each axis.

ii. Use the table feature of your graphing calculator to evaluate the function at the given values of \( x \). Record these results in a table next to your coordinate system on your graph paper.

iii. Plot the points in the table on your coordinate system then use them to draw the graph of the given function. Label the graph with its equation.

9. \( f(x) = \sqrt{x-4} \) at \( x = 4, 5, 6, 7, 8, 9, \) and 10.

10. \( f(x) = \sqrt{4-x} \) at \( x = -10, -8, -6, -4, -2, 0, 2, \) and 4.

In Exercises 11-14, the graph of the given function is a parabola, a graph that has a “U-shape.” A parabola has only one turning point. For each exercise, perform the following tasks.

i. Load the equation into the \( \text{Y}= \) menu of your graphing calculator. Adjust the \text{WINDOW} parameters so that the “turning point” (actually called the vertex) is visible in the viewing window.

ii. Make a reasonable copy of the image in the viewing window on your home-
work paper. Draw all lines with a ruler (including the axes), but draw curves freehand. Label and scale each axis with xmin, xmax, ymin, and ymax. Label the graph with its equation.

11. \( f(x) = x^2 - x - 30 \)
12. \( f(x) = 24 - 2x - x^2 \)
13. \( f(x) = 11 + 10x - x^2 \)
14. \( f(x) = x^2 + 11x - 12 \)

Each of the equations in Exercises 15-18 are called “cubic polynomials.” Each equation has been carefully chosen so that its graph has exactly two “turning points.” For each exercise, perform each of the following tasks.

i. Load the equation into the Y= menu of your graphing calculator and adjust the WINDOW parameters so that both “turning points” are visible in the viewing window.

ii. Copy the image on the screen onto your homework paper. Label and scale each axis with xmin, xmax, ymin, and ymax, then label the graph with its equation. Remember to draw all lines with a ruler.

15. \( f(x) = x^3 - 2x^2 - 29x + 30 \)
16. \( f(x) = -x^3 + 2x^2 + 19x - 20 \)
17. \( f(x) = x^3 + 8x^2 - 53x - 60 \)
18. \( f(x) = -x^3 + 16x^2 - 43x - 60 \)

Perform each of the following tasks for the equations in Exercises 19-22.

i. Load the equation into the Y= menu. Adjust the WINDOW parameters until you think all important behavior (“turning points,” etc.) is visible in the viewing window. Note: This is more difficult than it sounds, particularly when we have no advance notion of what the graph might look like. However, experiment with several settings until you “discover” the settings that exhibit the most important behavior.

ii. Copy the image on the screen onto your homework paper. Label and scale each axis with xmin, xmax, ymin, and ymax. Label the graph with its equation.

19. \( f(x) = 2x^2 - x - 465 \)
20. \( f(x) = x^3 - 24x^2 + 65x + 1050 \)
21. \( f(x) = x^4 - 2x^3 - 168x^2 + 288x + 3456 \)
22. \( f(x) = -x^4 - 3x^3 + 141x^2 + 523x - 660 \)
2.2 Solutions

1. Evaluate the function $f(x) = 2x + 1$ at $-2$, $-1$, $0$, and $1$.

\[
\begin{align*}
  f(-2) &= 2(-2) + 1 = -3 \\
  f(-1) &= 2(-1) + 1 = -1 \\
  f(0) &= 2(0) + 1 = 1 \\
  f(1) &= 2(1) + 1 = 3
\end{align*}
\]

Place these results in table (a) and plot them as shown in (b). There is enough evidence here to intuit that the graph of $f$ is the line shown in (b).

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f(x) = 2x + 1$</th>
<th>$(x, f(x))$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-2$</td>
<td>$-3$</td>
<td>$(-2, -3)$</td>
</tr>
<tr>
<td>$-1$</td>
<td>$-1$</td>
<td>$(-1, -1)$</td>
</tr>
<tr>
<td>$0$</td>
<td>$1$</td>
<td>$(0, 1)$</td>
</tr>
<tr>
<td>$1$</td>
<td>$3$</td>
<td>$(1, 3)$</td>
</tr>
</tbody>
</table>

3. Evaluate the function $f(x) = 3 - (1/2)x$ at $x = -2$, $0$, $2$, and $4$.

\[
\begin{align*}
  f(-2) &= 3 - (1/2)(-2) = 4 \\
  f(0) &= 3 - (1/2)(0) = 3 \\
  f(2) &= 3 - (1/2)(2) = 2 \\
  f(4) &= 3 - (1/2)(4) = 1
\end{align*}
\]

Place these results in table (a) and plot them as shown in (b). There is enough evidence here to intuit that the graph of $f$ is the line shown in (b).
5. Evaluate \( f(x) = x^2 - 2 \) at \( x = -3, -2, -1, 0, 1, 2, \) and 3.

\[
\begin{align*}
  f(-3) &= (-3)^2 - 2 = 7 \\
  f(-2) &= (-2)^2 - 2 = 2 \\
  f(-1) &= (-1)^2 - 2 = -1 \\
  f(0) &= (0)^2 - 2 = -2 \\
  f(1) &= (1)^2 - 2 = -1 \\
  f(2) &= (2)^2 - 2 = 2 \\
  f(3) &= (3)^2 - 2 = 7 \\
\end{align*}
\]

Place these results in table (a) and plot them as shown in (b). There is enough evidence here to intuit that the graph of \( f \) is the curve shown in (b).

<table>
<thead>
<tr>
<th>( x )</th>
<th>( f(x) = x^2 - 2 )</th>
<th>( (x, f(x)) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>7</td>
<td>(-3, 7)</td>
</tr>
<tr>
<td>-2</td>
<td>2</td>
<td>(-2, 2)</td>
</tr>
<tr>
<td>-1</td>
<td>-1</td>
<td>(-1, -1)</td>
</tr>
<tr>
<td>0</td>
<td>-2</td>
<td>(0, -2)</td>
</tr>
<tr>
<td>1</td>
<td>-1</td>
<td>(1, -1)</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>(2, 2)</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>(3, 7)</td>
</tr>
</tbody>
</table>

7. Evaluate \( f(x) = x^2/2 - 6 \) at \( x = -4, -2, 0, 2, \) and 4.

\[
\begin{align*}
  f(-4) &= (-4)^2/2 - 6 = 2 \\
  f(-2) &= (-2)^2/2 - 6 = -4 \\
  f(0) &= (0)^2/2 - 6 = -6 \\
  f(2) &= (2)^2/2 - 6 = -4 \\
  f(4) &= (4)^2/2 - 6 = 2 \\
\end{align*}
\]
Place these results in table (a) and plot them as shown in (b). There is enough evidence here to intuit that the graph of \( f \) is the curve shown in (b).

<table>
<thead>
<tr>
<th>( x )</th>
<th>( f(x) = \frac{x^2}{2} - 6 )</th>
<th>( (x, f(x)) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>2</td>
<td>(-4, 2)</td>
</tr>
<tr>
<td>-2</td>
<td>-4</td>
<td>(-2, -4)</td>
</tr>
<tr>
<td>0</td>
<td>-6</td>
<td>(0, -6)</td>
</tr>
<tr>
<td>2</td>
<td>-4</td>
<td>(2, -4)</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>(4, 2)</td>
</tr>
</tbody>
</table>

9. Load the function \( f(x) = \sqrt{x - 4} \) into Y1 as shown in (a). Select \text{TBLSET}, then highlight \text{ASK} for the independent variable and press \text{ENTER} (see (b)). It doesn’t matter what is entered for \text{TblStart} or \text{ΔTbl}. Select \text{TABLE} and enter the \( x \)-values 4, 5, 6, 7, 8, 9, and 10, as shown in (c).

Plot the points in table (c) in (d). This is enough to intuit that the graph of \( f \) is the curve shown in (d).
Chapter 2  Functions

11. Load the function \( f(x) = x^2 - x - 30 \) into \( Y1 \) as shown in (a). Adjust the WINDOW parameters as shown in (b). Push the GRAPH button to obtain the graph of \( f \) in (c).

[Diagram of graph]

Copy the image onto your homework as shown in (d).

13. Load the function \( f(x) = 11 + 10x - x^2 \) into \( Y1 \) as shown in (a). Adjust the WINDOW parameters as shown in (b). Push the GRAPH button to obtain the graph of \( f \) in (c).

[Diagram of graph]

Copy the image onto your homework as shown in (d).
15. Load the function $f(x) = x^3 - 2x^2 - 29x + 30$ into Y1 as shown in (a). Adjust the WINDOW parameters as shown in (b). Push the GRAPH button to obtain the graph of $f$ in (c).

Copy the image onto your homework as shown in (d).
17. Load the function \( f(x) = x^3 + 8x^2 - 53x - 60 \) into \( Y_1 \) as shown in (a). Adjust the \textsc{window} parameters as shown in (b). Push the \textsc{graph} button to obtain the graph of \( f \) in (c).

![Graph of \( f(x) = x^3 + 8x^2 - 53x - 60 \)](image)

Copy the image onto your homework as shown in (d).

19. Load the function \( f(x) = 2x^2 - x - 465 \) into \( Y_1 \) as shown in (a). Adjust the \textsc{window} parameters as shown in (b). Push the \textsc{graph} button to obtain the graph of \( f \) in (c).

![Graph of \( f(x) = 2x^2 - x - 465 \)](image)

Copy the image onto your homework as shown in (d).
21. Load the function $f(x) = x^4 - 2x^3 - 168x^2 + 288x + 3456$ into Y1 as shown in (a). Adjust the WINDOW parameters as shown in (b). Push the GRAPH button to obtain the graph of $f$ in (c).

Copy the image onto your homework as shown in (d).