Graph Vertical and Horizontal Lines

Can we graph an equation with only one variable? Just x and no y, or just y without an x? How will we make a table of values to get the points to plot?

Let’s consider the equation $x = -3$. The equation says that $x$ is always equal to $-3$, so its value does not depend on $y$. No matter what $y$ is, the value of $x$ is always $-3$.

To make a table of solutions, we write $-3$ for all the $x$ values. Then choose any values for $y$. Since $x$ does not depend on $y$, you can choose any numbers you like. But to fit the size of our coordinate graph, we’ll use 1, 2, and 3 for the $y$-coordinates as shown in the table.

$x = -3$

<table>
<thead>
<tr>
<th>$x$</th>
<th>$y$</th>
<th>$(x, y)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>1</td>
<td>(-3, 1)</td>
</tr>
<tr>
<td>-3</td>
<td>2</td>
<td>(-3, 2)</td>
</tr>
<tr>
<td>-3</td>
<td>3</td>
<td>(-3, 3)</td>
</tr>
</tbody>
</table>

Then plot the points and connect them with a straight line. Notice in Figure 11.12 that the graph is a vertical line.
Definition: Vertical line

A vertical line is the graph of an equation that can be written in the form $x = a$. The line passes through the x-axis at $(a, 0)$.

Example 11.20:

Graph the equation $x = 2$. What type of line does it form?

Solution

The equation has only variable, $x$, and $x$ is always equal to 2. We make a table where $x$ is always 2 and we put in any values for $y$.

$$
\begin{array}{ccc}
\text{x} & \text{y} & (x, y) \\
2 & 1 & (2, 1) \\
2 & 2 & (2, 2) \\
2 & 3 & (2, 3)
\end{array}
$$

Plot the points and connect them as shown.
The graph is a vertical line passing through the x-axis at 2.

Exercise 11.38:

Graph the equation: \( x = 5 \).

Exercise 11.39:

Graph the equation: \( x = -2 \).

What if the equation has \( y \) but no \( x \)? Let’s graph the equation \( y = 4 \). This time the \( y \)-value is a constant, so in this equation \( y \) does not depend on \( x \).

To make a table of solutions, write 4 for all the \( y \) values and then choose any values for \( x \).

We’ll use 0, 2, and 4 for the \( x \)-values.

\[
\begin{array}{ccc}
\text{x} & \text{y} & (\text{x}, \text{y}) \\
0 & 4 & (0, 4) \\
2 & 4 & (2, 4) \\
4 & 4 & (4, 4) \\
\end{array}
\]
Plot the points and connect them, as shown in Figure 11.13. This graph is a horizontal line passing through the y-axis at 4.

![Graph of a horizontal line](image)

**Figure 11.13**

**Definition: Horizontal Line**

A horizontal line is the graph of an equation that can be written in the form $y = b$. The line passes through the y-axis at $(0, b)$.

**Example 11.21:**

Graph the equation $y = -1$.

**Solution**

The equation $y = -1$ has only variable, $y$. The value of $y$ is constant. All the ordered pairs in the table have the same $y$-coordinate, $-1$. We choose 0, 3, and $-3$ as values for $x$.

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
<th>(x, y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>-1</td>
<td>(-3, -1)</td>
</tr>
<tr>
<td>0</td>
<td>-1</td>
<td>(0, -1)</td>
</tr>
<tr>
<td>3</td>
<td>-1</td>
<td>(3, -1)</td>
</tr>
</tbody>
</table>
The graph is a horizontal line passing through the y-axis at -1 as shown.

Exercise 11.40:

Graph the equation: \( y = -4 \).

Exercise 11.41:

Graph the equation: \( y = 3 \).

The equations for vertical and horizontal lines look very similar to equations like \( y = 4x \). What is the difference between the equations \( y = 4x \) and \( y = 4 \)?

The equation \( y = 4x \) has both \( x \) and \( y \). The value of \( y \) depends on the value of \( x \). The \( y \)-coordinate changes according to the value of \( x \).

The equation \( y = 4 \) has only one variable. The value of \( y \) is constant. The \( y \)-coordinate is always 4. It does not depend on the value of \( x \).

\[
y = 4x
\]

\[
\begin{array}{c|c|c}
 x & y & (x, y) \\
0 & 0 & (0, 0) \\
1 & 4 & (1, 4)
\end{array}
\]
$y = 4x$

2 8 (2, 8)

Notice that the equation $y = 4x$ gives a slanted line whereas $y = 4$ gives a horizontal line.

Example 11.22:

Graph $y = −3x$ and $y = −3$ in the same rectangular coordinate system.

Solution

Find three solutions for each equation. Notice that the first equation has the variable $x$, while the second does not. Solutions for both equations are listed.
\( \textcolor{red}{y = -3x} \)

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
<th>(x, y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>(0, 0)</td>
</tr>
<tr>
<td>1</td>
<td>-3</td>
<td>(1, -3)</td>
</tr>
<tr>
<td>2</td>
<td>-6</td>
<td>(2, -6)</td>
</tr>
</tbody>
</table>

\( y = -3 \)

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
<th>(x, y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-3</td>
<td>(0, -3)</td>
</tr>
<tr>
<td>1</td>
<td>-3</td>
<td>(1, -3)</td>
</tr>
<tr>
<td>2</td>
<td>-3</td>
<td>(2, -3)</td>
</tr>
</tbody>
</table>

The graph shows both equations.

Exercise 11.42:

Graph the equations in the same rectangular coordinate system: \( y = -4x \) and \( y = -4 \).

Exercise 11.43:
Graph the equations in the same rectangular coordinate system: \( y = 3 \) and \( y = 3x \).

**ACCESS ADDITIONAL ONLINE RESOURCES**

*Use a Table of Values*

*Graph a Linear Equation Involving Fractions*

*Graph Horizontal and Vertical Lines*

**Practice Makes Perfect**

**Recognize the Relation Between the Solutions of an Equation and its Graph**

For each ordered pair, decide (a) is the ordered pair a solution to the equation? (b) is the point on the line?

39. \( y = x + 2 \)
   1. (0, 2)
   2. (1, 2)
   3. (−1, 1)
   4. (−3, 1)

40. \( y = x − 4 \)
   1. (0, −4)
   2. (3, −1)
   3. (2, 2)
   4. (1, −5)

41. \( y = \frac{1}{2}x − 3 \)
   1. (0, −3)
   2. (2, −2)
   3. (−2, −4)
   4. (4, 1)

42. \( y = \frac{1}{3}x + 2 \)
   1. (0, 2)
   2. (3, 3)
   3. (−3, 2)
   4. (−6, 0)
Graph a Linear Equation by Plotting Points

In the following exercises, graph by plotting points.

43. \( y = 3x - 1 \)
44. \( y = 2x + 3 \)
45. \( y = -2x + 2 \)
46. \( y = -3x + 1 \)
47. \( y = x + 2 \)
48. \( y = x - 3 \)
49. \( y = -x - 3 \)
50. \( y = -x - 2 \)
51. \( y = 2x \)
52. \( y = 3x \)
53. \( y = -4x \)
54. \( y = -2x \)
55. \( y = \frac{1}{2}x + 2 \)
56. \( y = \frac{1}{3}x - 1 \)
57. \( y = \frac{4}{3}x - 5 \)
58. \( y = \frac{3}{2}x - 3 \)
59. \( y = -\frac{2}{5}x + 1 \)
60. \( y = -\frac{4}{5}x - 1 \)
61. \( y = -\frac{3}{2}x + 2 \)
62. \( y = -\frac{5}{3}x + 4 \)
63. \( x + y = 6 \)
64. \( x + y = 4 \)
65. \( x + y = -3 \)
66. \( x + y = -2 \)
67. \( x - y = 2 \)
68. \( x - y = 1 \)
69. \( x - y = -1 \)
70. \( x - y = -3 \)
71. \( -x + y = 4 \)
72. \( -x + y = 3 \)
73. \( -x - y = 5 \)
74. \( -x - y = 1 \)
75. \( 3x + y = 7 \)
76. \( 5x + y = 6 \)
77. \(2x + y = -3\)
78. \(4x + y = -5\)
79. \(2x + 3y = 12\)
80. \(3x - 4y = 12\)
81. \(\frac{1}{3}x + y = 2\)
82. \(\frac{1}{2}x + y = 3\)

**Graph Vertical and Horizontal lines**

In the following exercises, graph the vertical and horizontal lines.

83. \(x = 4\)
84. \(x = 3\)
85. \(x = -2\)
86. \(x = -5\)
87. \(y = 3\)
88. \(y = 1\)
89. \(y = -5\)
90. \(y = -2\)
91. \(x = \frac{7}{3}\)
92. \(x = \frac{5}{4}\)

In the following exercises, graph each pair of equations in the same rectangular coordinate system.

93. \(y = -\frac{1}{2}x\) and \(y = -\frac{1}{2}\)
94. \(y = -\frac{1}{3}x\) and \(y = -\frac{1}{3}\)
95. \(y = 2x\) and \(y = 2\)
96. \(y = 5x\) and \(y = 5\)

**Mixed Practice**

In the following exercises, graph each equation.

97. \(y = 4x\)
98. \(y = 2x\)
99. \(y = -\frac{1}{2}x + 3\)
100. \(y = \frac{1}{4}x - 2\)
101. \(y = -x\)
102. \(y = x\)
103. \( x - y = 3 \)
104. \( x + y = -5 \)
105. \( 4x + y = 2 \)
106. \( 2x + y = 6 \)
107. \( y = -1 \)
108. \( y = 5 \)
109. \( 2x + 6y = 12 \)
110. \( 5x + 2y = 10 \)
111. \( x = 3 \)
112. \( x = -4 \)

**Everyday Math**

113. **Motor home cost** The Robinsons rented a motor home for one week to go on vacation. It cost them $594 plus $0.32 per mile to rent the motor home, so the linear equation \( y = 594 + 0.32x \) gives the cost, \( y \), for driving \( x \) miles. Calculate the rental cost for driving 400, 800, and 1,200 miles, and then graph the line.

114. **Weekly earning** At the art gallery where he works, Salvador gets paid $200 per week plus 15% of the sales he makes, so the equation \( y = 200 + 0.15x \) gives the amount \( y \) he earns for selling \( x \) dollars of artwork. Calculate the amount Salvador earns for selling $900, $1,600, and $2,000, and then graph the line.

**Writing Exercises**

115. Explain how you would choose three \( x \)-values to make a table to graph the line \( y = \frac{1}{5}x - 2 \).

116. What is the difference between the equations of a vertical and a horizontal line?

**Self Check**

(a) After completing the exercises, use this checklist to evaluate your mastery of the objectives of this section.

<table>
<thead>
<tr>
<th>I can...</th>
<th>Confidently</th>
<th>With some help</th>
<th>No—I don't get it!</th>
</tr>
</thead>
<tbody>
<tr>
<td>graph a linear equation by plotting points.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>graph vertical and horizontal lines.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(b) After reviewing this checklist, what will you do to become confident for all objectives?

**Contributors**

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