If \( a \cdot b = 0 \), then either \( a = 0 \) or \( b = 0 \).

Note that this property states that at least one of the factors must be zero. This simple statement gives us a powerful result which is most often used with equations involving the products of binomials. For example, solve \((x + 5)(x - 2) = 0\).

By the Zero Product Property, since \((x + 5)(x - 2) = 0\), either \(x + 5 = 0\) or \(x - 2 = 0\).

Thus, \(x = -5\) or \(x = 2\).

The Zero Product Property can be used to find where a quadratic function crosses the \(x\)-axis. These points are the \(x\)-intercepts. Using the example above, if \(y = (x + 5)(x - 2)\), the \(x\)-intercepts would be \((-5, 0)\) and \((2, 0)\).

**Example 1**

Where does \(y = (x + 3)(x - 7)\) cross the \(x\)-axis?

Since \(y = 0\) at the \(x\)-axis, then \((x + 3)(x - 7) = 0\) and the Zero Product Property tells you that \(x = -3\) or \(x = 7\) so \(y = (x + 3)(x - 7)\) crosses the \(x\)-axis at \((-3, 0)\) and \((7, 0)\).

**Example 2**

Where does \(y = x^2 - x - 6\) cross the \(x\)-axis?

First factor \(x^2 - x - 6\) into \((x + 2)(x - 3)\) to get \(y = (x + 2)(x - 3)\). By the Zero Product Property, the \(x\)-intercepts are \((-2, 0)\) and \((3, 0)\).

**Example 3**

Graph \(y = x^2 - x - 6\).

Since you know the \(x\)-intercepts from Example 2, you already have two points to graph. Make a table of values to get additional points.

<table>
<thead>
<tr>
<th>(x)</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>(y)</td>
<td>0</td>
<td>-4</td>
<td>-6</td>
<td>-6</td>
<td>-4</td>
<td>0</td>
<td>6</td>
</tr>
</tbody>
</table>

**Example 4**

Graph \(y > x^2 - x - 6\).

First graph \(y = x^2 - x - 6\). Use a dashed curve. Second, pick a point not on the parabola and substitute it into the inequality. For example, testing point \((0, 0)\) in \(y > x^2 - x - 6\) gives \(0 > -6\) which is a true statement. This means that \((0, 0)\) is a solution to the inequality as well as all points inside the curve. Shade the interior of the parabola.
Problems

Solve the following equations using the Zero Product Property.

1. \((x - 2)(x + 3) = 0\)  
2. \(2x(x + 5)(x + 6) = 0\)  
3. \((x - 18)(x - 3) = 0\)

4. \(4x^2 - 5x - 6 = 0\)  
5. \((2x - 1)(x + 2) = 0\)  
6. \(2x(x - 3)(x + 4) = 0\)

7. \(3x^2 - 13x - 10 = 0\)  
8. \(2x^2 - x = 15\)

Use factoring and the Zero Product Property to find the \(x\)-intercepts of each parabola below. Express your answer as ordered pair(s).

9. \(y = x^2 - 3x + 2\)  
10. \(y = x^2 - 10x + 25\)  
11. \(y = x^2 - x - 12\)

12. \(y = x^2 - 4x - 5\)  
13. \(y = x^2 + 2x - 8\)  
14. \(y = x^2 + 6x + 9\)

15. \(y = x^2 - 8x + 16\)  
16. \(y = x^2 - 9\)

Graph the following inequalities. Be sure to use a test point to determine which region to shade. Your solutions to the previous problems might be helpful.

17. \(y < x^2 - 3x + 2\)  
18. \(y > x^2 - 10x + 25\)  
19. \(y \leq x^2 - x - 12\)

20. \(y \geq x^2 - 4x - 5\)  
21. \(y > x^2 + 2x - 8\)  
22. \(y \geq x^2 + 6x + 9\)

23. \(y < x^2 - 8x + 16\)  
24. \(y \leq x^2 - 9\)
Answers

1. \( x = 2, -3 \)  
2. \( x = 0, -5, -6 \)  
3. \( x = 18, 3 \)  
4. \( x = -0.75, 2 \)  
5. \( x = 0.5, -2 \)  
6. \( x = 0, 3, -4 \)  
7. \( x = \frac{-2}{3}, x = 5 \)  
8. \( x = -2.5, x = 3 \)  
9. \((1,0), (2,0)\)  
10. \((5,0)\)  
11. \((-3,0), (4,0)\)  
12. \((5,0), (-1,0)\)  
13. \((-4,0), (2,0)\)  
14. \((-3,0)\)  
15. \((4,0)\)  
16. \((3,0), (-3,0)\)  
17.  
18.  
19.  
20.  
21.  
22.  
23.  
24.