Please Help Help Help!!! A Parabola Has Vertex (4,3).If One X-intercept Is 1, Find The Other X-intercept.ASAP!!!!!

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Understanding the properties of parabolas is essential for students and enthusiasts of algebra and coordinate geometry. This article aims to guide you through solving the problem of finding the other x-intercept of a parabola given its vertex and one x-intercept. We will explore the fundamental concepts, step-by-step solutions, and important tips to deepen your understanding of parabolas.

Introduction to Parabolas

A parabola is a symmetric, U-shaped curve that can open upwards, downwards, left, or right depending on its equation. It is the graph of a quadratic function, typically expressed in the form:

- Standard form: $y = ax^2 + bx + c$
- Vertex form: $y = a(x - h)^2 + k$

where (h, k) is the vertex of the parabola, and a determines the direction and width of the parabola.

Key properties of a parabola include:

- Vertex: the highest or lowest point of the parabola.
- Axis of symmetry: the vertical line that passes through the vertex.
- X-intercepts (roots): points where the parabola crosses the x-axis.
- Y-intercept: point where the parabola crosses the y-axis.

In this context, knowing the vertex and one x-intercept allows us to determine the other x-intercept, which is crucial for understanding the parabola's shape and position.

Understanding the Given Data

The problem provides:

- The vertex: (4, 3)
- One x-intercept: 1
- The task: Find the other x-intercept

Let's analyze what this information tells us about the parabola.

Vertex (4, 3)

This indicates the parabola reaches its maximum or minimum at the point (4, 3). Whether it opens upwards or downwards depends on the value of 'a' in the quadratic equation, but typically, the vertex form makes this explicit.

X-intercept at x = 1

The parabola crosses the x-axis at x = 1, meaning y = 0 at x = 1.

Note: Since the parabola has symmetry about its axis of symmetry, if we can find the axis of symmetry, we can find the other x-intercept.

Step-by-Step Solution Approach

To find the other x-intercept, we will use the properties of the parabola and the symmetry about its axis of symmetry.

Step 1: Write the equation in vertex form

The vertex form of a quadratic is:

$$ y = a(x - h)^2 + k $$

where (h, k) is the vertex.

Given (h, k) = (4, 3), the equation becomes:

$$ y = a(x - 4)^2 + 3 $$

Our goal is to find the value of 'a' using the known x-intercept at x = 1.

Step 2: Use the known point to find 'a'

At x = 1, y = 0 (because it is an x-intercept). Substituting into the

equation:

$$ 0 = a(1 - 4)^2 + 3 $$

Calculate:

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

So:

$$ 0 = 9a + 3 $$

Solve for 'a':

$$ 9a = -3 $$

$$ a = -\frac{1}{3} $$

This negative value indicates the parabola opens downward.

Step 3: Write the full quadratic equation

Now, substitute 'a' back into the vertex form:

$$ y = -\frac{1}{3}(x - 4)^2 + 3 $$

Step 4: Find the other x-intercept

Since (4, 3) is the vertex and the parabola is symmetric about the vertical line x = 4, the other x-intercept will be equidistant from x = 4} but on the opposite side.

Given one x-intercept at x = 1, which is 3 units to the left of x=4, the other x-intercept should be 3 units to the right:

$$ x = 4 + 3 = 7 $$

Alternatively, we can confirm this algebraically.

Method A: Using the quadratic formula

Set y = 0 in the equation:

$$ 0 = -\frac{1}{3}(x - 4)^2 + 3 $$

Rearranged:

$$ \frac{1}{3}(x - 4)^2 = 3 $$

Multiply both sides by 3:

$$ (x - 4)^2 = 9 $$

Take square root:

$$ x - 4 = \pm 3 $$

Thus:

$$ x = 4 \pm 3 $$

which gives:

- $x = 4 + 3 = 7$
- $x = 4 - 3 = 1$

We already know $x = 1$; therefore, the other x-intercept is at $x = 7$.

Summary of Findings

Known Data	Calculations	Result
Vertex (4, 3)	Used in vertex form	Equation: $y = -1/3(x - 4)^2 + 3$
Known x-intercept	y=0 at x=1	'a' found: -1/3
Other x-intercept	Symmetry about x=4	x=7

The other x-intercept is at $x = 7$.

Additional Insights and Tips

Understanding Symmetry in Parabolas

A key property of parabolas is their symmetry about a vertical axis through the vertex. This symmetry implies that for any point on the parabola, there is a corresponding point equidistant from the axis of symmetry on the opposite side.

- If one x-intercept is at $x = 1$ and the vertex is at $x = 4$, the horizontal distance is 3 units.
- Therefore, the other x-intercept is at $x = 4 + 3 = 7$.

Using the Quadratic Formula

When the quadratic is in vertex form, solving for x-intercepts involves setting y=0 and solving:

$$ 0 = a(x - h)^2 + k $$

which simplifies to:

$$ (x - h)^2 = -\frac{k}{a} $$

and then taking square roots, considering both positive and negative roots.

Practice Problems for Better Understanding

- Given a parabola with vertex (2, -1) and an x-intercept at 0, find the other x-intercept.
- The parabola opens upwards, has vertex (5, 4), and passes through (3, 0). Find its equation and x-intercepts.

Practicing such problems enhances your comprehension of parabolas, symmetry, and quadratic equations.

Conclusion

Understanding how to find the other x-intercept of a parabola given its vertex and one x-intercept is a fundamental skill in algebra and coordinate geometry. By leveraging the symmetry property of parabolas and converting the vertex form to standard form, you can efficiently solve such problems.

In this specific case, the vertex at (4, 3) and an x-intercept at x=1 led us to determine the other x-intercept at x=7. Remember to verify your solutions by substituting back into the original equations, and always consider the properties of symmetry and the quadratic formula as powerful tools in your problem-solving arsenal.

Key Takeaways:

- The parabola's axis of symmetry passes through its vertex.
- The other x-intercept is equidistant from the axis of symmetry.
- Converting between vertex and standard forms simplifies calculations.
- Always verify solutions by substitution.

Mastering these concepts will enable you to confidently tackle similar quadratic problems and deepen your understanding of the geometry of parabolas.

Frequently Asked Questions

How do I find the other x-intercept of a parabola with a known vertex and one x-intercept?

You can use the symmetry property of parabolas: the vertex lies midway between the two x-intercepts. If one x-intercept is known, the other is found by reflecting it across the vertex's x-coordinate.

Given the vertex (4, 3) and one x-intercept at 1, how do I find the other x-intercept?

Since the vertex is at x=4 and one x-intercept is at x=1, the distance from the vertex to this intercept is 3 units. The other intercept will be 3 units on the other side of the vertex, at x=7.

What is the formula to find the x-intercepts of a parabola with a known vertex?

If the parabola's vertex is at (h, k), and it opens upwards or downwards, the x-intercepts can be found using the symmetry about x=h. Once one x-intercept is known, the other is at x = 2h - x1.

Can I find the parabola's equation using the vertex and intercepts?

Yes. Knowing the vertex and one x-intercept allows you to write the parabola's equation in vertex form and solve for the other intercept or coefficients accordingly.

Is it necessary to find the parabola's equation to determine the other x-intercept?

No, it's not necessary. You only need the symmetry property about the vertex to find the other x-intercept once you know one x-intercept.

What is the significance of the vertex (4, 3) in relation to the parabola's x-intercepts?

The vertex's x-coordinate (4) is the axis of symmetry for the parabola. The x-intercepts are equidistant from this line, so if one intercept is at x=1, the other is at x=7.

If the parabola opens upwards, how does that affect the location of the x-intercepts?

If it opens upwards and has real x-intercepts, they are located symmetrically on either side of the vertex along the x-axis, at equal distances from x=4.

How do I verify my answer for the other x-intercept?

You can substitute the x-value into the parabola's equation (once found) or use the symmetry property to confirm the location relative to the vertex.

What is the final answer for the other x-intercept in this problem?

The other x-intercept is at x=7.

Can I generalize this method for any parabola with a known vertex and one x-intercept?

Yes. The key idea is that the x-intercepts are symmetric with respect to the vertex's x-coordinate, so the other intercept can always be found using the reflection formula x=2h - x1.

Additional Resources

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When it comes to understanding quadratic functions, one of the most common challenges students face is determining the x-intercepts when given certain properties of the parabola, such as its vertex. In this guide, we will walk through the step-by-step process of solving a problem involving a parabola with a known vertex at (4, 3), where one x-intercept is given as 1, and the goal is to find the other x-intercept. This type of problem is typical in algebra and calculus, and mastering it is fundamental to understanding the properties of quadratic functions.

Understanding the Problem

Let's first restate the problem in our own words:

Given a parabola with a vertex at (4, 3), and knowing that one x-intercept is at 1, find the other x-intercept.

Key information:

- Vertex: (4, 3)
- Known x-intercept: 1
- Unknown x-intercept: ?

The quick reaction might be to plug values into some generic quadratic form, but a more systematic approach involves understanding the properties of parabolas, especially symmetry with respect to the vertex, and the relationship between roots (x-intercepts) and the vertex.

Fundamental Concepts

Before diving into calculations, let's review some core concepts related to quadratic functions:

1. Standard Form of a Quadratic Equation
A quadratic function can be written as:
$$ y = ax^2 + bx + c $$

2. Vertex Form of a Quadratic Equation
Alternatively, the vertex form expresses a parabola as:
$$ y = a(x - h)^2 + k $$
where:
- (h, k) is the vertex of the parabola.
- a determines the direction (upward or downward opening) and the width.

3. Symmetry of Parabolas
A parabola is symmetric about its vertical axis passing through the vertex. This symmetry means:
- The x-coordinate of the vertex, h, is exactly halfway between the roots (x-intercepts).
- If the roots are x_1 and x_2, then:
$$ h = \frac{x_1 + x_2}{2} $$

4. Relationship Between Roots and Vertex
Given the vertex form:
$$ y = a(x - h)^2 + k $$
and roots x_1 and x_2, the roots are symmetric around h:
$$ x_1 = h - d $$
$$ x_2 = h + d $$
where d is the distance from the vertex's x-coordinate to either root.

Step-by-Step Solution Approach

Now, let's delve into solving the specific problem:

Step 1: Write the Equation in Vertex Form

Given:
- Vertex: (4, 3)
- One x-intercept: 1

We can express the parabola as:
$$ y = a(x - 4)^2 + 3 $$

Our goal:
- Find $ a $ using the known x-intercept at $ x = 1 $.

Step 2: Find the Value of $ a $

Since $ x = 1 $ is an x-intercept, the parabola passes through (1, 0):
$$ 0 = a(1 - 4)^2 + 3 $$
Calculate:
$$ 0 = a(-3)^2 + 3 $$
$$ 0 = 9a + 3 $$

Solve for $ a $:
$$ 9a = -3 $$
$$ a = -\frac{1}{3} $$

Thus, the equation of the parabola in vertex form is:
$$ y = -\frac{1}{3}(x - 4)^2 + 3 $$

Step 3: Find the Other x-intercept

To find the other root, set $ y = 0 $:
$$ 0 = -\frac{1}{3}(x - 4)^2 + 3 $$

Rearranged:
$$ -\frac{1}{3}(x - 4)^2 = -3 $$
Multiply both sides by -3:
$$ (x - 4)^2 = 9 $$

Take square roots:
$$ x - 4 = \pm 3 $$

Calculate both possibilities:

- When $ x - 4 = 3 $:
$$ x = 4 + 3 = 7 $$

- When $ x - 4 = -3 $:
$$ x = 4 - 3 = 1 $$

We already knew $ x = 1 $ is an x-intercept, so the other x-intercept is at:
$$ \boxed{7} $$

Summary of the Solution

- The parabola's equation in vertex form:
$$ y = -\frac{1}{3}(x - 4)^2 + 3 $$
- Known x-intercept: $x = 1$
- Other x-intercept: $\boxed{7}$

Additional Insights and Tips

Symmetry and Roots
Remember that the parabola's roots are symmetric about the vertex's x-coordinate. Since one root is at 1, which is 3 units away from the vertex at 4, the other root must be 3 units away on the opposite side:

$$ x_{other} = 4 + 3 = 7 $$

This symmetry principle often simplifies solving similar problems.

Verifying the Roots
Always verify your roots by plugging back into the original equation, especially when working with quadratic functions:

$$ y = -\frac{1}{3}(x - 4)^2 + 3 $$

Check at $x = 7$:

$$ y = -\frac{1}{3}(7 - 4)^2 + 3 = -\frac{1}{3}(3)^2 + 3 = -\frac{1}{3}(9) + 3 = -3 + 3 = 0 $$

Confirmed as an x-intercept.

Final Thought: How to Approach Similar Problems

When faced with a parabola with known vertex and one x-intercept:

1. Write the equation in vertex form using the vertex.
2. Use the given x-intercept to find the parameter a.
3. Solve for the other x-intercept by setting $y = 0$ and solving the resulting quadratic.
4. Leverage symmetry: The x-intercepts are equidistant from the vertex's x-coordinate.

Summary

This problem exemplifies how understanding the properties of quadratic

functions—particularly vertex form and symmetry—can help efficiently find unknown roots. By expressing the parabola in vertex form, using known points to find the leading coefficient, and applying symmetry principles, you can solve for unknown x-intercepts with ease. Remember to verify your solutions, and always consider the geometric interpretation, as it provides valuable insight into the problem's structure.

In conclusion, with a vertex at (4, 3) and an x-intercept at 1, the other x-intercept is at 7. Mastering these steps not only helps in solving this particular problem but also builds a strong foundation for tackling more complex quadratic equations in algebra, calculus, and beyond.

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