

If $G(x) = 3x^2 - 4x + 1$, What Is The Value Of $G(-2)$?

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Understanding how to evaluate functions at specific points is a fundamental skill in algebra. Whether you are a student brushing up on quadratic functions or a teacher preparing lesson plans, knowing how to find the value of a function like $G(x)$ at particular inputs is essential. In this article, we will explore the process of calculating $G(-2)$ for the given quadratic function $G(x) = 3x^2 - 4x + 1$. We will delve into the step-by-step method, discuss the importance of functions, and provide tips for mastering similar problems.

What Is a Function?

Before diving into the specific problem, it's important to understand the basic concept of a function.

Definition of a Function

A function is a relation between a set of inputs and a set of permissible outputs where each input corresponds to exactly one output. In mathematical terms, a function G assigns to each input x a unique output $G(x)$.

Examples of Functions

- Linear functions: $G(x) = 2x + 3$
- Quadratic functions: $G(x) = ax^2 + bx + c$
- Polynomial functions: $G(x) = x^3 - 4x + 5$

Understanding these types helps in recognizing how to evaluate them at specific points.

Understanding the Given Function $G(x) = 3x^2 - 4x + 1$

The function provided is a quadratic function, characterized by its degree of 2. Let's break down its components:

- Coefficient of x^2 : 3
- Coefficient of x : -4
- Constant term: 1

Quadratic functions graph as parabolas, opening upwards if the coefficient of x^2 (a) is positive and downwards if it is negative. In our case, since $a = 3$, the parabola opens upwards.

Significance of Each Term

- The $3x^2$ term dominates the growth of the function as x becomes large in magnitude.
- The $-4x$ term influences the shape and position of the parabola.
- The constant 1 shifts the graph vertically.

Our goal is to find $G(-2)$, that is, the value of the function when $x = -2$.

How to Calculate $G(-2)$: Step-by-Step Process

Calculating $G(-2)$ involves substituting x with -2 in the function and simplifying the expression.

Step 1: Write the Function and Substitute $x = -2$

$$G(x) = 3x^2 - 4x + 1$$

$$G(-2) = 3(-2)^2 - 4(-2) + 1$$

Step 2: Compute the Square of -2

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

So,

$$G(-2) = 3 \cdot 4 - 4(-2) + 1$$

Step 3: Simplify Each Term

- $3 \cdot 4 = 12$
- $-4(-2) = 8$
- The constant term remains 1

Now, $G(-2) = 12 + 8 + 1$

Step 4: Final Calculation

$$G(-2) = 12 + 8 + 1 = 21$$

Therefore, the value of G at $x = -2$ is 21.

Understanding the Result: $G(-2) = 21$

The calculation shows that when x is -2, the function $G(x)$ yields a value of 21. This is useful in various contexts:

- Graphing the function: Knowing specific points helps sketch the parabola.
- Solving equations: If $G(x) = k$, knowing $G(-2)$ helps determine if -2 is a solution.
- Analyzing function behavior: Evaluating at different points reveals the shape and properties of the graph.

Additional Techniques for Evaluating Functions

While plugging in specific values is straightforward, here are some tips and techniques to make the process easier:

1. Use of Substitution

Always write down the substituted value clearly to avoid errors.

2. Simplify Step-by-Step

Break down complex expressions into smaller parts, especially when dealing with exponents or multiple terms.

3. Remember Order of Operations

Follow PEMDAS (Parentheses, Exponents, Multiplication and Division, Addition and Subtraction) to ensure accurate results.

4. Use a Calculator for Complex Calculations

When dealing with large exponents or multiple terms, calculators can help verify your work.

Practice Problems to Reinforce Concepts

To master evaluating functions like $G(x) = 3x^2 - 4x + 1$, try solving these practice problems:

1. Find $G(0)$
2. Calculate $G(3)$
3. Determine $G(-1)$
4. Evaluate $G(2)$

Let's quickly see the solutions for these:

- $G(0) = 3(0)^2 - 4(0) + 1 = 1$
- $G(3) = 3(9) - 4(3) + 1 = 27 - 12 + 1 = 16$
- $G(-1) = 3(1) - 4(-1) + 1 = 3 + 4 + 1 = 8$
- $G(2) = 3(4) - 4(2) + 1 = 12 - 8 + 1 = 5$

Practicing with various inputs enhances understanding and speed.

Real-World Applications of Quadratic Functions

Quadratic functions are not just theoretical; they have many practical uses:

- Projectile motion in physics, modeling the path of objects.
- Economics, to analyze profit and cost functions.
- Engineering, for designing parabolic reflectors and antennas.
- Computer graphics, for rendering curves and shapes.

Understanding how to evaluate these functions at specific points allows professionals and students to analyze real-world scenarios effectively.

Summary: Key Takeaways

- To find $G(-2)$ for $G(x) = 3x^2 - 4x + 1$, substitute x with -2 .
- Carefully evaluate each term, following the order of operations.
- The calculated value $G(-2) = 21$ demonstrates how the function responds at that specific input.
- Mastery of evaluating functions enables better understanding of their behavior and applications.

Conclusion

Evaluating a quadratic function at a specific point, such as $G(-2)$, is a fundamental skill in algebra that builds a foundation for more advanced topics like calculus and analytical geometry. The step-by-step process—substituting the value, simplifying the expression, and calculating the result—can be applied to any polynomial function. By practicing these techniques regularly and understanding the underlying concepts, students and professionals can confidently analyze functions and interpret their significance in various fields.

Remember, the key to mastering function evaluation lies in careful substitution, systematic simplification, and consistent practice. Whether you're solving homework problems or applying these concepts in real-world contexts, these skills form the backbone of mathematical problem-solving.

Frequently Asked Questions

How do you evaluate $G(-2)$ for the function $G(x) = 3x^2 - 4x + 1$?

To evaluate $G(-2)$, substitute -2 for x in the function: $G(-2) = 3(-2)^2 - 4(-2) + 1 = 3(4) + 8 + 1 = 12 + 8 + 1 = 21$.

What is the value of $G(x)$ when $x = -2$ for the quadratic function $G(x) = 3x^2 - 4x + 1$?

The value of $G(-2)$ is 21.

If $G(x) = 3x^2 - 4x + 1$, what does $G(-2)$ evaluate to?

$G(-2)$ evaluates to 21.

Is the function $G(x) = 3x^2 - 4x + 1$ increasing or decreasing at $x = -2$?

Since $G(x)$ is a quadratic with a positive leading coefficient, it is decreasing before the vertex and increasing after. Evaluating $G(-2)$ gives a specific value, but to determine increase or decrease at that point, you'd analyze the derivative. The derivative $G'(x) = 6x - 4$, so at $x = -2$, $G'(-2) = -12 - 4 = -16$, which is negative, indicating $G(x)$ is decreasing at $x = -2$.

What is the significance of calculating $G(-2)$ for the quadratic function $G(x) = 3x^2 - 4x + 1$?

Calculating $G(-2)$ helps find the output of the function at $x = -2$, which can be useful for graphing, understanding the function's behavior at specific points, or solving related problems involving the quadratic.

Can you verify the calculation of $G(-2)$ for $G(x) = 3x^2 - 4x + 1$?

Yes. Substituting $x = -2$: $G(-2) = 3(-2)^2 - 4(-2) + 1 = 3(4) + 8 + 1 = 12 + 8 + 1 = 21$. So, the calculation is correct, and $G(-2) = 21$.

Additional Resources

Understanding the Function $G(x) = 3x^2 - 4x + 1$ and Calculating $G(-2)$

Mathematics often appears as a language of patterns, relationships, and problem-solving that underpin countless scientific and real-world applications. One fundamental aspect of this language involves functions—rules that assign each input a specific output. This article delves into a particular quadratic function, $G(x) = 3x^2 - 4x + 1$, and focuses on evaluating its value at a specific point, $x = -2$. By exploring the structure of the function, methodical calculation, and the broader significance of such evaluations, readers will gain a comprehensive understanding of how to analyze and interpret quadratic functions in mathematical practice.

Introduction to the Function $G(x) = 3x^2 - 4x + 1$

What Is a Quadratic Function?

A quadratic function is a polynomial function of degree two, typically expressed in the form:

$$f(x) = ax^2 + bx + c$$

where:

- $a \neq 0$,
- b and c are constants.

Quadratic functions are characterized by their parabolic graphs, which can open upward or downward depending on the sign of a . They are fundamental in algebra, physics, economics, and various fields that involve modeling situations with quadratic relationships.

In our specific case, the function:

$$G(x) = 3x^2 - 4x + 1$$

has:

- $a = 3$,
- $b = -4$,
- $c = 1$.

This particular quadratic has a positive leading coefficient ($a = 3$), indicating that its parabola opens upward.

Significance of Evaluating $G(x)$ at a Specific Point

Calculating the value of a function at a particular point—here, $x = -2$ —serves multiple purposes:

- Understanding the function's behavior at specific inputs: It provides the output corresponding to a given input,
- Graphical interpretation: Helps in plotting the graph accurately,
- Analyzing the function's properties: Such as locating its vertex, axis of symmetry, and roots,
- Application in real-world contexts: For example, in physics or economics, where the input variable might represent time, distance, or cost.

In this case, finding $G(-2)$ involves substituting -2 into the function and simplifying to find the output.

Methodology for Calculating $G(-2)$

Step-by-Step Substitution

To evaluate $G(-2)$, follow these steps:

1. Identify the formula:

$$G(x) = 3x^2 - 4x + 1$$

2. Substitute $x = -2$:

$$G(-2) = 3(-2)^2 - 4(-2) + 1$$

3. Calculate each term carefully:

- $(-2)^2 = 4$
- $3 \times 4 = 12$
- $-4 \times -2 = 8$

4. Combine the results:

$$G(-2) = 12 + 8 + 1$$

5. Final addition:

$$G(-2) = 21$$

This straightforward substitution and calculation process exemplifies the fundamental approach to evaluate functions at any given point.

Alternative Methods and Confirmatory Checks

While the substitution method is direct and most common, alternative strategies or checks can reinforce accuracy:

- Tabular approach: Construct a table of x and $G(x)$ values around the point of interest to verify the calculation.
- Graphical verification: Plotting the parabola or using graphing tools to see the approximate value at $x = -2$.
- Using symmetry: Since quadratic functions are symmetric about their vertex, understanding the parabola's shape can provide a check on the plausibility of the computed value.

In academic or applied settings, employing multiple methods can bolster confidence in the results.

Deeper Insights into the Function $G(x) = 3x^2 - 4x + 1$

Vertex of the Parabola

The vertex of a parabola represents its maximum or minimum point, which is crucial in understanding the overall shape and key features of the quadratic.

- Vertex formula:

$$\left[x_v = -\frac{b}{2a} \right]$$

- Applying to $G(x)$:

$$\left[x_v = -\frac{-4}{2 \times 3} = \frac{4}{6} = \frac{2}{3} \right]$$

- Corresponding y-coordinate:

$$\left[G\left(\frac{2}{3}\right) = 3\left(\frac{2}{3}\right)^2 - 4\left(\frac{2}{3}\right) + 1 \right]$$

Calculating:

$$\begin{aligned} &\left[\left(\frac{2}{3}\right)^2 = \frac{4}{9} \right] \\ &\left[3 \times \frac{4}{9} = \frac{12}{9} = \frac{4}{3} \right] \\ &\left[-4 \times \frac{2}{3} = -\frac{8}{3} \right] \end{aligned}$$

Adding these:

$$\left[G\left(\frac{2}{3}\right) = \frac{4}{3} - \frac{8}{3} + 1 = -\frac{4}{3} + 1 \right]$$

Expressing 1 as $\left(\frac{3}{3} \right)$:

$$\begin{aligned} &\left[-\frac{4}{3} + \frac{3}{3} = -\frac{1}{3} \right] \end{aligned}$$

Therefore, the vertex is at:

$$\left(\frac{2}{3}, -\frac{1}{3}\right)$$

This point indicates the minimum value of the parabola, given that $(a = 3 > 0)$.

Implications of $G(-2) = 21$

Knowing the value at $(x = -2)$, which is 21, provides a reference point on the parabola:

- Since $(G(-2) = 21)$, and the vertex is at roughly $(x = 0.666)$ with a minimum value of $(-\frac{1}{3})$, the point $(x = -2)$ is located to the left of the vertex.
- The high value of 21 relative to the vertex's minimum suggests the parabola's steep upward opening on this side, emphasizing the quadratic's rapid growth away from the vertex.

Broader Context and Applications of Quadratic Functions

Real-World Applications

Quadratic functions like $G(x)$ are ubiquitous in modeling:

- Projectile motion in physics: The height of an object over time follows a quadratic pattern.
- Economics: Cost functions, profit optimization, and revenue models often use quadratics.
- Engineering: Structural analysis and design frequently involve quadratic relationships.
- Biology: Population models under certain conditions can be quadratic.

Evaluating specific points, such as $G(-2)$, helps in understanding system behavior at particular instances or inputs, facilitating better decision-making and analysis.

Mathematical Significance and Educational Value

Analyzing quadratic functions enhances:

- Problem-solving skills: Developing techniques for substitution, factoring, completing the square, and using the quadratic formula.
- Graphical understanding: Visualizing functions to interpret their properties intuitively.
- Algebraic reasoning: Connecting algebraic manipulations with geometric interpretations.

Understanding how to evaluate $G(x)$ at specific points builds foundational skills essential for higher mathematics, including calculus and analytical geometry.

Conclusion and Final Thoughts

In summary, the task of determining the value of $G(-2)$ for the quadratic function $G(x) = 3x^2 - 4x + 1$ exemplifies core principles in algebra and function analysis. Through systematic substitution and careful calculation, we find that $G(-2) = 21$. This process not only reinforces foundational skills such as substitution and arithmetic but also connects to broader concepts like the vertex, graph shape, and the function's behavior across its domain.

Quadratic functions serve as a cornerstone in both theoretical and applied mathematics, offering insights into natural phenomena, economic models, and engineering systems. Recognizing how to evaluate these functions at specific points empowers learners and professionals alike to interpret data, predict outcomes, and solve complex problems with confidence.

By mastering such calculations, students and practitioners develop a deeper appreciation for the elegance and utility of quadratic functions, laying the groundwork for exploring more advanced mathematical topics and real-world applications.

In conclusion, the evaluation of $G(-2)$ demonstrates a fundamental mathematical skill that connects algebraic manipulation with geometric intuition and practical understanding. Whether in an academic setting, technical profession, or everyday problem-solving, such analytical techniques are invaluable tools in the mathematician's toolkit.

If $G \times 3x^2 - 4x - 1$ What Is The Value Of G ?

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