If G(x) = 4x2- 5, Find G(-2)

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Understanding how to evaluate functions at specific points is a fundamental aspect of algebra. In this article, we will explore the process of finding G(-2) when given the function $G(x) = 4x^2 - 5$. We'll break down the steps involved, discuss the importance of functions in mathematics, and provide additional insights into related concepts to enhance your understanding.

Introduction to Functions and Their Significance

What Is a Function?

A function is a relation between a set of inputs and a set of permissible outputs with the property that each input is related to exactly one output. In simple terms, a function assigns each input exactly one output.

For example, consider the function $G(x) = 4x^2 - 5$. Here, G is the function name, and x is the input variable. The expression $4x^2 - 5$ defines how the output is calculated based on the input x.

Why Are Functions Important?

Functions are fundamental in mathematics because they model real-world phenomena such as physics, economics, biology, and engineering. They help us understand relationships between variables, analyze trends, and make predictions.

Understanding the Given Function $G(x) = 4x^2 - 5$

Breakdown of the Function Components

- $4x^2$: This term indicates that the input x is squared (multiplied by itself) and then multiplied by 4.
- -5: This is a constant term that shifts the parabola vertically downward by 5 units.

Graphically, $G(x) = 4x^2 - 5$ represents a parabola opening upward because the coefficient of x^2 (which is 4) is positive.

Properties of the Function

- Vertex: The vertex of the parabola can be found at $x=0$, $y=-5$.
- Axis of symmetry: The parabola is symmetric about the line $x=0$.
- Y-intercept: When $x=0$, $G(0) = -5$.

Understanding these properties helps in graphing and analyzing the function's behavior.

Calculating G(-2): Step-by-Step Process

Step 1: Recognize the Input Value

The problem asks us to find G(-2). This means we need to substitute $x = -2$ into the function.

Step 2: Substitute the Value into the Function

Replace x with -2 in the expression:

$G(-2) = 4(-2)^2 - 5$

Step 3: Simplify the Expression

- Calculate $(-2)^2$:
$(-2) \times (-2) = 4$
- Multiply by 4:
$4 \times 4 = 16$
- Subtract 5:
$16 - 5 = 11$

Step 4: Write the Final Answer

$G(-2) = 11$

This straightforward process demonstrates how to evaluate a function at a specific point. The result, 11, is the output when the input x is -2.

Understanding the Result and Its Significance

Interpreting G(-2) = 11

In practical terms, if the function G(x) models a real-world scenario—such as the profit (in thousands of dollars) based on a certain variable—then substituting x = -2 gives a specific outcome, which in this case is 11.

Additional Examples of Function Evaluation

To deepen your understanding, consider evaluating G(x) at other points:

- $G(0) = 4(0)^2 - 5 = -5$
- $G(1) = 4(1)^2 - 5 = 4 - 5 = -1$
- $G(3) = 4(3)^2 - 5 = 4(9) - 5 = 36 - 5 = 31$

These examples highlight the importance of substitution and simplification in evaluating functions.

Graphing the Function $G(x) = 4x^2 - 5$

Plotting Key Points

To visualize the function, plot the key points obtained by evaluating G(x) at various x-values:

x	G(x)
-3	4(9) - 5 = 36 - 5 = 31
-2	11 (as calculated)
-1	4(1) - 5 = 4 - 5 = -1
0	-5 (vertex)
1	-1
2	11
3	31

Sketching the Parabola

Using these points, you can sketch the parabola, noting that it opens upward with its vertex at (0, -5). The symmetry about the y-axis is evident from points (-x, G(-x)) and (x, G(x)).

Practical Applications of Function Evaluation

In Real-World Contexts

Functions like $G(x) = 4x^2 - 5$ are used across various fields:

- Physics: To model projectile motion where the quadratic term represents acceleration due to gravity.
- Economics: To determine profit or cost functions based on input variables.
- Biology: To model growth rates that follow quadratic patterns.

Why Calculating G(-2) Matters

Knowing how to evaluate functions at specific points allows professionals and students alike to interpret data, make predictions, and solve problems efficiently.

Additional Tips for Evaluating Functions

1. **Always substitute carefully:** Be attentive to signs and operations.

2. **Simplify step-by-step:** Break down complex expressions into manageable parts.

3. **Check your work:** Verify calculations to avoid mistakes.

4. **Visualize the function:** Graphs can provide insights into the behavior of the function.

Conclusion

Understanding how to evaluate functions like $G(x) = 4x^2 - 5$ at specific points, such as $x = -2$, is a vital skill in mathematics. It not only helps in solving algebraic problems but also in applying mathematics to real-world scenarios. By following systematic steps—substituting the value, simplifying the expression, and interpreting the result—you can confidently analyze various functions. Remember that functions are powerful tools that describe relationships between variables, and mastering their evaluation opens the door to a deeper understanding of mathematical concepts and their applications in diverse fields.

Frequently Asked Questions

What is the value of G(-2) if G(x) = 4x^2 - 5?

G(-2) = 4(-2)^2 - 5 = 4(4) - 5 = 16 - 5 = 11.

How do you evaluate G(-2) for the function G(x) = 4x^2 - 5?

Substitute x = -2 into the function: G(-2) = 4(-2)^2 - 5, then simplify to find the answer.

What is the process to find G(-2) when given the quadratic function G(x) = 4x^2 - 5?

Plug in -2 for x, calculate the square, multiply by 4, then subtract 5 to get the result.

Is G(-2) the same as G(2) for G(x) = 4x^2 - 5?

Yes, because the function involves x^2, which is always positive, so G(-2) = G(2).

What type of function is G(x) = 4x^2 - 5, and what does evaluating G(-2) tell us?

It's a quadratic function, and evaluating G(-2) gives the output value when x is -2, which is 11.

Can you generalize how to find G(a) for any value of a in the function G(x) = 4x^2 - 5?

Yes, replace x with a in the function: G(a) = 4a^2 - 5, then compute the result.

Why does plugging in -2 into G(x) = 4x^2 - 5 give the same result as plugging in 2?

Because x^2 is symmetric about zero, so both -2 and 2 yield the same squared value, resulting in the same G(x).

Additional Resources

Understanding the Function $G(x) = 4x^2 - 5$ and Calculating G(-2)

In the realm of algebra and mathematical functions, understanding how to evaluate functions at specific points is fundamental. The function $G(x) = 4x^2 - 5$ presents an excellent opportunity to explore quadratic functions, their properties, and the process of substitution. This article aims to dissect the function step-by-step, providing a comprehensive understanding of how to evaluate G(-2) and the broader implications of such calculations. By exploring the structure of G(x), the significance of quadratic functions, and the detailed methodology for substitution, readers will gain both procedural knowledge and conceptual insights into this classic algebraic problem.

Introduction to Functions and Their Significance

What Is a Function?

A function is a relation between a set of inputs and a set of permissible outputs where each input is related to exactly one output. In mathematical notation, functions are often expressed as G(x), where 'x' represents the input variable, and G(x) indicates the output derived from the input via a specific rule or formula.

For example, in the function $G(x) = 4x^2 - 5$, the rule involves squaring the input, multiplying by four, and then subtracting five. This rule applies to all real numbers, making G(x) a quadratic function—a type characterized by a degree of two.

Why Are Functions Important?

Functions serve as mathematical models for real-world phenomena, including physics, economics, biology, and engineering. They help us understand relationships, predict outcomes, and analyze behaviors within systems. Recognizing the behavior of specific functions at certain points (like G(-2)) allows us to interpret data and solve practical problems.

Dissecting the Function $G(x) = 4x^2 - 5$

Structural Components of the Function

The function $G(x) = 4x^2 - 5$ is a quadratic function, characterized by the squared term, which influences its shape and properties.

- Quadratic Term ($4x^2$): This term dominates the behavior of the function, determining its parabola shape, opening upwards due to the positive coefficient.
- Coefficient (4): Multiplies the squared term, affecting the parabola's steepness.
- Constant Term (-5): Shifts the parabola vertically downward by five units, impacting the function's output regardless of the input.

Graphical Representation and Behavior

Understanding the graph of $G(x)$ provides insights into its properties:

- Vertex: The minimum point of the parabola for this upward-opening graph.
- Axis of Symmetry: The vertical line passing through the vertex.
- Y-Intercept: The value of $G(x)$ when $x=0$.
- X-Intercepts: Points where $G(x)=0$, found via solving the quadratic equation.

Plotting $G(x)$ reveals a parabola opening upwards with its vertex at a specific point, which can be calculated and analyzed for further insights.

Step-by-Step Calculation of G(-2)

Substitution Method

Calculating $G(-2)$ involves substituting -2 into the function in place of x:

$G(-2) = 4(-2)^2 - 5$

This process comprises:

1. Evaluating the squared term: $(-2)^2$
2. Multiplying by 4: 4 multiplied by the squared value
3. Subtracting 5: Adjusting the result according to the constant term

Detailed Calculation Process

Let's proceed with the calculation:

1. Calculate the square: $(-2)^2 = 4$
2. Multiply by 4: $4 \times 4 = 16$
3. Subtract 5: $16 - 5 = 11$

Therefore, $G(-2) = 11$.

Interpreting the Result

The value 11 signifies the output of the function G at the input $x = -2$. Geometrically, this corresponds to the point (-2, 11) on the graph of $G(x)$. Understanding this specific value allows us to analyze the function's behavior at that point, predict trends, or integrate it into larger calculations.

Broader Context and Mathematical Insights

Properties of the Quadratic Function $G(x) = 4x^2 - 5$

Analyzing the function's properties helps in understanding its behavior beyond a single point:

- Vertex: The vertex of the parabola is at the minimum point, which can be found using the vertex formula for quadratics.
- Axis of Symmetry: The line $x = -b/(2a)$, where $a = 4$ and $b = 0$ in this case.
- Range: Since the parabola opens upward, the minimum value is at the vertex, and the range is all values greater than or equal to that minimum.

Finding the Vertex

For the quadratic $G(x) = ax^2 + bx + c$, the vertex's x-coordinate is at $-b/(2a)$. Here:

- $a = 4$
- $b = 0$
- $c = -5$

Calculating:

$x = -0 / (2 \times 4) = 0$

Substituting $x=0$ into $G(x)$:

$G(0) = 4(0)^2 - 5 = -5$

Thus, the vertex is at (0, -5), which is the minimum point of the parabola.

Implications of the Vertex and the Value G(-2) = 11

Knowing that $G(-2) = 11$ and the vertex at (0, -5) provides a clearer picture of the function's shape:

- The point (-2, 11) lies above the vertex, indicating the parabola is rising at $x = -2$.
- The value of $G(-2)$ being positive and relatively large compared to the vertex's minimum illustrates the quadratic's rapid growth away from its minimum point.

Applications and Significance of Evaluating G(x) at Specific Points

Real-World Applications of Quadratic Functions

Quadratic functions like $G(x) = 4x^2 - 5$ are prevalent in various fields:

- Physics: Describing projectile trajectories where height depends quadratically on time.
- Economics: Modeling profit or cost functions that have quadratic relationships.
- Engineering: Analyzing stress-strain relationships or optimization problems.

Why Calculating G(-2) Matters

Evaluating the function at specific points like $x = -2$ can:

- Assist in understanding the behavior of systems modeled by quadratic functions.
- Help in graphing the function accurately.
- Enable solving real-world problems where the input x represents a measurable quantity, and the output $G(x)$ models an outcome or cost.

Advanced Topics and Further Exploration

Extension to Other Values and Functions

While this article focuses on G(-2), similar procedures apply to any input:

- For $x = 3$, $G(3) = 4(3)^2 - 5 = 4(9) - 5 = 36 - 5 = 31$
- For fractional or negative inputs, the same substitution rules apply.

Graphing and Visualization

Using graphing calculators or software, one can visualize G(x), identify key points, and analyze its symmetry, concavity, and intercepts. Such visualizations deepen understanding and aid in teaching or problem-solving.

Connection to Other Mathematical Concepts

This calculation connects to broader topics such as:

- Quadratic equations and their solutions
- Parabolic functions and their transformations
- The vertex form of quadratic functions
- Optimization problems in calculus and algebra

Conclusion: The Power of Substitution and Function Analysis

Evaluating $G(x) = 4x^2 - 5$ at a specific point like $x = -2$ exemplifies fundamental algebraic techniques and deepens comprehension of quadratic functions. The straightforward substitution process reveals the function's value at that point, providing insights into its behavior, shape, and real-world applications. As algebra forms the backbone of mathematics, mastering such evaluations not only enhances problem-solving skills but also prepares students and professionals to tackle complex analytical tasks across disciplines. Understanding the structure and properties of quadratic functions, along with the process of evaluation, empowers learners to analyze, interpret, and leverage mathematical models effectively in diverse contexts.

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