Evaluate The Expression When X=2.x^2-6x+3

Evaluate The Expression When X=2.x^2-6x+3 is a fundamental task in algebra that involves substituting a specific value into an algebraic expression and simplifying to find its numerical result. This process is essential for understanding how functions behave and for solving real-world problems where the value of a variable impacts the outcome. In this article, we will explore the steps to evaluate the expression when X equals a specific value, delve into methods for simplifying algebraic expressions, and discuss practical applications of this skill in various mathematical and real-world contexts.

Understanding the Expression 2x^2 - 6x + 3

Before diving into the evaluation process, it is important to understand the structure of the given expression. The expression 2x^2 - 6x + 3 is a quadratic polynomial, characterized by its degree of 2. It consists of three terms:

- 2x^2: The quadratic term, which involves the variable squared.
- -6x: The linear term, involving the variable to the first power.
- +3: The constant term, which remains unchanged regardless of the value of x.

Understanding the components of the expression helps in grasping how changes in x affect the overall value of the expression.

Steps to Evaluate the Expression When X=2

Evaluating the expression involves a straightforward substitution process and simplification. Let's walk through these steps carefully.

Step 1: Substitute the Given Value of X

The first step is to replace every occurrence of x in the expression with the given value, which in this case is 2.

- Original expression: 2x^2 - 6x + 3
- Substituted expression: 2(2)^2 - 6(2) + 3

Step 2: Calculate the Powers and Products

Next, evaluate the powers and products within the expression.

- Calculate 2^2 = 4
- Multiply 2 by 4: 2 4 = 8
- Multiply -6 by 2: -6 2 = -12

Now, the expression becomes:

8 - 12 + 3

Step 3: Simplify the Expression

Combine the terms step-by-step:

- 8 - 12 = -4
- -4 + 3 = -1

Thus, the value of the expression when x = 2 is -1.

Practice Problems for Evaluation

To solidify understanding, consider practicing with different values of x and similar expressions. Here are some examples:

1. Evaluate 2x^2 - 6x + 3 when x = 0
2. Evaluate 2x^2 - 6x + 3 when x = -1
3. Evaluate 2x^2 - 6x + 3 when x = 3

Working through these will help reinforce the evaluation process and improve confidence in handling algebraic expressions.

Using the Expression in Different Contexts

Evaluating algebraic expressions is not just an academic exercise; it has numerous practical applications across various fields. Understanding how to manipulate and evaluate expressions is crucial for solving real-world problems.

Applications in Geometry and Physics

In geometry, quadratic expressions often describe curves such as parabolas. Evaluating the expression at different points helps analyze the shape and position of these curves.

In physics, quadratic functions model phenomena like projectile motion. Evaluating the expression at specific times (values of x) can determine the height or position of an object in motion.

Applications in Economics and Business

Economists utilize quadratic models to predict revenue, cost, and profit functions. Evaluating the expressions at specific quantities (x values) allows for optimal decision-making and profit maximization.

Applications in Engineering and Technology

Engineers often use quadratic equations to design structures, analyze stress, and optimize systems. Evaluating expressions at various points is essential for testing and validation.

Graphing the Expression 2x^2 - 6x + 3

Graphing the quadratic expression provides visual insight into its behavior and helps in understanding the significance of evaluation at specific points.

Identifying Key Features

- Vertex: The highest or lowest point of the parabola, found using the vertex formula x = -b/(2a). For the expression 2x^2 - 6x + 3:

- a = 2, b = -6

- x = -(-6)/(2 2) = 6/4 = 1.5

- Plug x = 1.5 into the expression to find y-coordinate:

2(1.5)^2 - 6(1.5) + 3 = 2(2.25) - 9 + 3 = 4.5 - 9 + 3 = -1.5

- Vertex: (1.5, -1.5)

- Axis of Symmetry: The vertical line x = 1.5.

- Y-intercept: When x = 0, y = 3.

- X-intercepts: Solve 2x^2 - 6x + 3 = 0 to find the roots.

Solving for X-Intercepts (Roots)

To find where the graph crosses the x-axis, set the expression equal to zero and solve:

$$2x^2 - 6x + 3 = 0$$

Apply the quadratic formula:

$$x = [-b \pm \sqrt{(b^2 - 4ac)}] / 2a$$

Where:
$a = 2$, $b = -6$, $c = 3$

Calculate discriminant:

$$D = (-6)^2 - 4\ 2\ 3 = 36 - 24 = 12$$

Compute roots:

$$x = [6 \pm \sqrt{12}] / 4$$

Simplify $\sqrt{12}$:

$$\sqrt{12} = 2\sqrt{3}$$

Thus,

$$x = [6 \pm 2\sqrt{3}] / 4$$

Divide numerator and denominator by 2:

$$x = [3 \pm \sqrt{3}] / 2$$

So, the roots are:

- $x = (3 + \sqrt{3}) / 2$

- $x = (3 - \sqrt{3}) / 2$

These points tell us where the parabola crosses the x-axis.

Conclusion

Evaluating the expression $2x^2 - 6x + 3$ when $x=2$ is a fundamental skill that demonstrates the core principles of algebraic manipulation, substitution, and simplification. Whether applied in mathematics, physics, economics, or engineering, this process allows us to understand how a function behaves at specific points and provides a foundation for analysis and problem-solving. By mastering the steps involved—substituting the value, simplifying, and interpreting the results—you can confidently evaluate similar expressions and apply these techniques across various disciplines. Remember that practice and visualization, such as graphing, enhance comprehension and enable more advanced mathematical exploration.

Frequently Asked Questions

What is the value of the expression x^2 - 6x + 3 when x = 2?

When x = 2, the expression becomes 2^2 - 6(2) + 3 = 4 - 12 + 3 = -5.

How do you evaluate the quadratic expression x^2 - 6x + 3 at a specific value of x?

Substitute the given value of x into the expression and perform the calculations step by step to find the result.

What is the value of the expression when x = -1?

For x = -1, the expression is (-1)^2 - 6(-1) + 3 = 1 + 6 + 3 = 10.

How can you find the minimum or maximum value of the quadratic expression x^2 - 6x + 3?

Complete the square or use the vertex formula x = -b/(2a). For this quadratic, the vertex occurs at x = 3, giving the minimum value.

What is the significance of the value x=2 in evaluating the expression?

Plugging x=2 into the expression allows us to evaluate its value at that specific point, which is useful for graphing or solving equations.

Can you find the value of the expression when x = 0?

Yes, when x=0, the expression is 0^2 - 6(0) + 3 = 3.

Is the expression x^2 - 6x + 3 always positive, negative, or variable depending on x?

It depends on x; the quadratic can be positive or negative depending on the value of x, with the minimum at the vertex x=3.

How does the value of the expression change as x increases beyond 2?

Since the quadratic opens upwards, the value increases as x moves away from the vertex, which is at x=3, either increasing or decreasing depending on the direction.

What is the value of the expression when x = 2, and how is it calculated?

At x=2, substitute into the expression: $2^2 - 6(2) + 3 = 4 - 12 + 3 = -5$.

Additional Resources

Evaluate The Expression When X=2: A Comprehensive Analysis

Understanding how to evaluate algebraic expressions at specific values of variables is fundamental in algebra and mathematics. In this detailed exploration, we will focus on the expression $x^2 - 6x + 3$ and analyze how to evaluate it when $x=2$. We will delve into the steps involved, the mathematical principles underlying the process, potential pitfalls, and broader implications of such evaluations. Whether you're a student brushing up on algebra skills or someone interested in the nuances of mathematical expressions, this comprehensive guide aims to deepen your understanding.

Introduction to Algebraic Expressions and Evaluation

What Is an Algebraic Expression?

An algebraic expression is a mathematical phrase involving variables, numbers, and operation symbols. Unlike equations, they do not contain an equals sign. For example, $x^2 - 6x + 3$ is an algebraic expression involving the variable x, exponents, and constants.

Key components:
- Variables: Symbols representing unknown or changing quantities (here, x)
- Constants: Fixed numbers (here, 3)
- Operations: Addition, subtraction, multiplication, division, and exponents

The Process of Evaluation

Evaluating an algebraic expression at a specific value of a variable involves substituting the given value into the expression and simplifying the resulting numerical expression.

Steps:
1. Identify the variable to substitute (here, $x=2$)
2. Replace every occurrence of the variable with the given value
3. Simplify the expression step-by-step
4. Interpret the resulting numerical value

Step-by-Step Evaluation of $x^2 - 6x + 3$ at $x=2$

Substitution

Start by replacing x with 2:

$$
x^2 - 6x + 3 \Rightarrow (2)^2 - 6 \times 2 + 3
$$

Simplification

Calculate each term:

- $(2)^2 = 4$
- $6 \times 2 = 12$

Now, substitute back:

$$
4 - 12 + 3
$$

Proceed to simplify:

$$
(4 - 12) + 3 = -8 + 3 = -5
$$

Result:

$$
\boxed{-5}
$$

Thus, when $x=2$, the value of the expression $x^2 - 6x + 3$ is -5.

Deeper Insights into the Evaluation Process

Understanding the Underlying Mathematics

The process of substitution and simplification is grounded in fundamental algebraic rules:

- Order of Operations: Parentheses, exponents, multiplication/division, addition/subtraction (PEMDAS)
- Substitution: Replacing variables with specific values
- Simplification: Combining like terms and performing calculations step-by-step

Why Is Evaluation Important?

Evaluating expressions at specific points helps in various mathematical contexts:

- Graphing functions: understanding the shape and key points
- Solving real-world problems: calculating actual quantities
- Analyzing behavior: maxima, minima, and intercepts
- Preparing for calculus: limits, derivatives, and integrals

Potential Pitfalls in Evaluation

While the process seems straightforward, common mistakes include:

- Incorrect substitution: forgetting to replace all instances of the variable
- Order of operations errors: performing calculations out of order
- Sign errors: misinterpreting negative signs or coefficients
- Miscalculations in exponents: forgetting to square or cube correctly

Being meticulous and following the correct sequence ensures accurate results.

Exploring the Nature of the Expression $x^2 - 6x + 3$

Quadratic Expression Characteristics

The given expression is quadratic, with the general form $ax^2 + bx + c$. Here:

- $a=1$
- $b=-6$
- $c=3$

Quadratic functions are parabolas when graphed, with their shape and position determined by these coefficients.

Vertex and Axis of Symmetry

The vertex of the parabola described by $y = x^2 - 6x + 3$ can be found using the vertex formula:

$$
x_{vertex} = -\frac{b}{2a} = -\frac{-6}{2 \times 1} = \frac{6}{2} = 3
$$

The corresponding y-coordinate:

$$
f(3) = (3)^2 - 6 \times 3 + 3 = 9 - 18 + 3 = -6
$$

Vertex point: $(3, -6)$

Axis of symmetry: $x=3$

Evaluating at Other Values of x

While the focus here is $x=2$, exploring other points provides insight into the behavior of the quadratic:

x	$x^2 - 6x + 3$	Calculation	Result
0	$0^2 - 6 \times 0 + 3$	$0 - 0 + 3$	3
1	$1 - 6 + 3$	$1 - 6 + 3$	-2
2	$4 - 12 + 3$	-5	-5
3	$9 - 18 + 3$	-6	-6
4	$16 - 24 + 3$	-5	-5
5	$25 - 30 + 3$	-2	-2

This table illustrates the parabola's symmetry about $x=3$, with the minimum point at the vertex.

Applications of Evaluating Expressions at Specific Values

Graphing Functions

By calculating the value of $y = x^2 - 6x + 3$ at multiple x-values, you can plot points to visualize the parabola. Knowing the minimum point (vertex) and other key points helps in drawing an accurate graph.

Problem Solving and Real-World Contexts

Suppose this quadratic models a real-world scenario, such as the profit of a business depending on units sold x. Evaluating at $x=2$ gives specific insight into profit at that sales level.

Mathematical Analysis

- Determining when the expression equals a particular value
- Finding maximum or minimum values
- Solving quadratic inequalities

Broader Context and Related Topics

Quadratic Formula and Roots

The roots of the quadratic $x^2 - 6x + 3$ are found via the quadratic formula:

$$
x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}
$$

Calculating:

$$
x = \frac{6 \pm \sqrt{36 - 12}}{2} = \frac{6 \pm \sqrt{24}}{2} = \frac{6 \pm 2\sqrt{6}}{2} = 3 \pm \sqrt{6}
$$

These roots indicate the x-values where the expression equals zero.

Completing the Square

Rewriting the expression:

$$
x^2 - 6x + 3 = (x^2 - 6x + 9) - 6 = (x - 3)^2 - 6
$$

This form clearly shows the vertex at $(3, -6)$ and confirms the minimum value.

Implications of Evaluation in Calculus

In calculus, evaluating a function at a point is crucial for:

- Computing derivatives (slope at a point)
- Determining limits
- Finding critical points and analyzing function behavior

Summary and Final Thoughts

Evaluating the expression $x^2 - 6x + 3$ at $x=2$ is a straightforward process involving substitution and careful arithmetic. However, understanding this process deeply reveals much about the nature of quadratic functions, their graphs, and their applications across mathematics and real-world problems.

Key takeaways:

- Accurate substitution and order of operations are vital for correct evaluation.
- Quadratic expressions can be analyzed for their vertex, roots, and symmetry.
- Evaluation at specific points aids in graphing, problem-solving, and understanding function behavior.
- Alternative forms like vertex form provide insights into the function's properties.

By mastering the evaluation of algebraic expressions at given points, students and enthusiasts develop

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