If You Evaluate The Integral Expression Blank 1 Add Your Answer 12x-1|dx 5 Points The Result Is Blank

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When working with integrals in calculus, understanding how to evaluate an indefinite integral is fundamental. The phrase "If You Evaluate The Integral Expression Blank 1 Add Your Answer 12x-1|dx 5 Points The Result Is Blank" hints at a typical problem where you are asked to find the antiderivative of a given function. In this case, the function appears to be 12x - 1, and the task involves integrating this expression with respect to x. The phrase "Add Your Answer" suggests that this is a problem designed for practice or assessment, perhaps in a classroom or online learning environment.

In this comprehensive guide, we will explore the process of evaluating such integrals step-by-step, including techniques, rules, and tips to accurately compute the result. Whether you are a student preparing for exams or someone interested in mastering calculus, this article will serve as an in-depth resource.

Understanding the Basic Integral of a Polynomial Function

Before diving into the specific integral expression, it's essential to understand the fundamental concept of integrating polynomial functions like 12x - 1.

What Is an Integral?

An integral, specifically an indefinite integral, represents the antiderivative of a function. It is the reverse process of differentiation.

- Indefinite integral notation: ∫ f(x) dx
- Result: A family of functions F(x) such that F'(x) = f(x)

Common Rules for Integrating Polynomials

Integrating polynomials involves applying the power rule:

\[
\int x^n dx = \frac{x^{n+1}}{n+1} + C, \quad \text{for } n \neq -1
\]

where C is the constant of integration.

For linear functions like 12x - 1, the process involves integrating each term separately.

Step-by-Step Process to Evaluate the Integral of 12x - 1

Given the integral:

$$
\int (12x - 1) dx
$$

Let's walk through the steps:

Step 1: Break the Integral into Simpler Parts

Use the linearity of integrals:

$$
\int (12x - 1) dx = \int 12x dx - \int 1 dx
$$

Step 2: Integrate Each Term Separately

Apply the power rule:

- For $\int 12x dx$:

$$
\int 12x dx = 12 \int x dx = 12 \times \frac{x^2}{2} = 6x^2
$$

- For $\int 1 dx$:

$$
\int 1 dx = x
$$

Step 3: Combine the Results and Add the Constant of Integration

Putting it all together:

$$
\int (12x - 1) dx = 6x^2 - x + C
$$

where C is the constant of integration, representing the family of antiderivatives.

Final Answer and Interpretation

The integral of the function $12x - 1$ with respect to x is:

$$
\boxed{6x^2 - x + C}
$$

This result provides the antiderivative, which can be used for various applications such as calculating areas under curves, solving differential equations, and modeling real-world phenomena.

Additional Tips for Evaluating Integrals

To excel in evaluating integrals similar to this, consider the following tips:

1. Always Break Down the Integral

Decompose complex integrals into sums or differences of simpler integrals to simplify calculations.

2. Remember the Power Rule and Constants

Apply the power rule consistently, and factor out constants to streamline the process.

3. Include the Constant of Integration

For indefinite integrals, always add C to represent the family of solutions.

4. Practice with Different Functions

Work on integrating various functions—polynomials, exponentials, trigonometric functions—to build proficiency.

Common Variations and Related Problems

Understanding how to handle different types of integrals can enhance your calculus skills. Here are some related problems and their solutions:

1. Integrate a Quadratic Polynomial

Example: $\int (3x^2 + 4x + 5) dx$

Solution:

$$
\int 3x^2 dx = x^3
$$

$$
\int 4x dx = 2x^2
$$

$$
\int 5 dx = 5x
$$

Result:

$$
x^3 + 2x^2 + 5x + C
$$

2. Integrate a Function with Negative Exponents

Example: $\int x^{-2} dx$

Solution:

$$
\int x^{-2} dx = \frac{x^{-1}}{-1} + C = -\frac{1}{x} + C
$$

Understanding the Context of the Problem

The phrase "Add Your Answer 12x-1|dx 5 Points The Result Is Blank" suggests this is part of a quiz or test where students are expected to compute the indefinite integral of a given expression. The "5 Points" indicates the weight of the question, emphasizing its importance in assessment settings.

In real-world applications, such integrals appear in physics when calculating displacement from velocity functions, in economics for marginal analysis, and in engineering for signal processing.

Summary

- To evaluate $\int (12x - 1) dx$, use the linearity of integrals and the power rule.
- The key steps involve integrating each term separately and then combining the results.
- The final answer is $6x^2 - x + C$.

Conclusion

Mastering the evaluation of integrals like \(\int (12x - 1) dx\) is essential for understanding calculus and its applications. By following systematic steps—breaking the integral down, applying basic rules, and combining results—you can confidently compute indefinite integrals involving linear functions. Practice with different functions and problem types to deepen your understanding and improve your problem-solving skills in calculus.

Remember, the constant of integration \(C\) is always included in indefinite integrals, symbolizing the infinite family of antiderivatives. Keep practicing, and you'll find that evaluating integrals becomes more intuitive and straightforward.

Frequently Asked Questions

How do I evaluate the integral of |12x - 1| with respect to x?

To evaluate $\int|12x - 1| dx$, first find where the expression inside the absolute value changes sign, split the integral at that point, and then integrate each part separately considering the sign of the expression.

What is the critical point where 12x - 1 equals zero?

Set $12x - 1 = 0$, which gives $x = 1/12$. This is where the expression inside the absolute value changes from negative to positive.

How do I handle the absolute value when integrating |12x - 1|?

Split the integral at $x = 1/12$. For x less than 1/12, write $|12x - 1|$ as $-(12x - 1)$; for x greater than 1/12, write it as $12x - 1$, and then integrate accordingly.

What is the indefinite integral of |12x - 1|?

The indefinite integral is piecewise: for $x < 1/12$, it's $-\int(12x - 1) dx + C$; for $x > 1/12$, it's $\int(12x - 1) dx + C$. Evaluating these gives different expressions depending on the interval.

How do I find the exact value of the integral over a specific interval?

Determine the interval bounds, split at $x = 1/12$ if necessary, evaluate the indefinite integral in each sub-interval, and sum the results to find the definite integral.

What is the result of integrating |12x - 1| dx from 0 to some

point x?

Calculate by splitting the integral at x = 1/12: from 0 to 1/12, integrate -(12x - 1); from 1/12 to x, integrate 12x - 1, then combine the results.

Can you provide a simplified expression for the indefinite integral of |12x - 1|?

Yes. The indefinite integral is:
- For x < 1/12: $-6x^2 + x + C$
- For x > 1/12: $6x^2 - x + C$, adjusted to match at x = 1/12.

What is the value of the definite integral of |12x - 1| dx from x = 0 to x = 1/4?

Split at x = 1/12:
- From 0 to 1/12, integrate -(12x - 1): evaluate at the bounds.
- From 1/12 to 1/4, integrate (12x - 1): evaluate at the bounds.

Sum both results for the total.

How do I interpret the 'Add Your Answer 12x-1|dx 5 Points The Result Is Blank' question?

This appears to be a prompt asking you to evaluate the integral of |12x - 1| dx over a specified interval, leading to a numerical result that fills in the 'Blank' space once computed.

Additional Resources

If You Evaluate The Integral Expression Blank 1 Add Your Answer 12x-1|dx 5 Points The Result Is Blank

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Introduction

Integral calculus, a fundamental branch of mathematics, deals with the concept of accumulation, area, and antiderivatives. For students, educators, and mathematicians alike, evaluating indefinite and definite integrals forms an essential skill. Among the myriad integral expressions encountered, a specific type often appears in exercises and examinations: the indefinite integral involving a linear function inside an absolute value. This article delves deeply into the process of evaluating integrals of the form:

$$
\int |12x - 1|\, dx
$$

with the goal of understanding the methodology, the challenges involved, and the precise result.

Understanding the Integral: Context and Significance

Why is this integral important?

Evaluating $\int |ax + b|\, dx$ (where a and b are constants) is a classic problem that introduces students to the concept of absolute value functions within integrals. These integrals are significant because:

- They model real-world problems involving quantities that change sign or have different behaviors over intervals.
- They require understanding of piecewise functions and their integration.
- They serve as foundational exercises for more advanced topics such as piecewise integration, optimization in calculus, and integral applications.

The specific expression: $\int |12x - 1|\, dx$

The integral involves a linear expression $12x - 1$, whose absolute value's behavior depends on the sign of the expression. The challenge lies in correctly handling the absolute value by splitting the integral at the point where the expression equals zero, known as the critical point or the "break point."

Decomposing the Integral: Handling Absolute Values

Step 1: Find the critical point where the integrand's sign changes

Set the expression inside the absolute value to zero:

$$
12x - 1 = 0 \Rightarrow x = \frac{1}{12}
$$

This point divides the real line into two regions:

- For $x < \frac{1}{12}$, $12x - 1 < 0$, so $|12x - 1| = -(12x - 1) = 1 - 12x$.
- For $x > \frac{1}{12}$, $12x - 1 > 0$, so $|12x - 1| = 12x - 1$.

Step 2: Express the integral as a piecewise integral

Suppose we want to evaluate the indefinite integral:

$$
\int |12x - 1|\, dx =
\begin{cases}
\int (1 - 12x)\, dx, & x < \frac{1}{12} \\
\int (12x - 1)\, dx, & x > \frac{1}{12}
\end{cases}
$$

The indefinite integral will then be a combination of these two, with a constant of integration.

Calculating the Integral: Step-by-Step Approach

For \(x < \frac{1}{12}\):

\[
\int (1 - 12x)\, dx
\]

- Integrate term-by-term:

\[
\int 1\, dx = x
\]
\[
\int -12x\, dx = -12 \cdot \frac{x^2}{2} = -6x^2
\]

- Combining:

\[
\boxed{
\int (1 - 12x)\, dx = x - 6x^2 + C_1
}
\]

For \(x > \frac{1}{12}\):

\[
\int (12x - 1)\, dx
\]

- Integrate term-by-term:

\[
\int 12x\, dx = 12 \cdot \frac{x^2}{2} = 6x^2
\]
\[
\int -1\, dx = -x
\]

- Combining:

\[
\boxed{
\int (12x - 1)\, dx = 6x^2 - x + C_2
}
\]

Final indefinite integral expression:

\[
\int |12x - 1|\, dx =
\begin{cases}
x - 6x^2 + C_1, & x < \frac{1}{12} \\
6x^2 - x + C_2, & x > \frac{1}{12}
\end{cases}
\]

The constants \(C_1\) and \(C_2\) are arbitrary constants of integration, which can be combined into a single constant if the integral is considered over the entire real line or a specific interval.

Evaluating the Definite Integral: An Example

Suppose the integral is to be evaluated over a specific interval, say \([a, b]\). The process involves:

1. Identifying whether the interval crosses the critical point \(x = \frac{1}{12}\).
2. Splitting the integral at \(x = \frac{1}{12}\) if necessary.
3. Applying the appropriate piecewise integral expressions.

Example: \(\int_{0}^{\frac{1}{6}} |12x - 1|\, dx\)

- Since \(0 < \frac{1}{12}\), the integral from 0 to \(\frac{1}{12}\):

\[
\int_{0}^{\frac{1}{12}} (1 - 12x)\, dx
\]

- From \(\frac{1}{12}\) to \(\frac{1}{6}\):

\[
\int_{\frac{1}{12}}^{\frac{1}{6}} (12x - 1)\, dx
\]

Calculations:

- First part:

\[
\left[x - 6x^2 \right]_0^{\frac{1}{12}} = \left(\frac{1}{12} - 6 \left(\frac{1}{12}\right)^2 \right) - (0 - 0) = \frac{1}{12} - 6 \cdot \frac{1}{144} = \frac{1}{12} - \frac{6}{144} = \frac{1}{12} - \frac{1}{24} = \frac{2}{24} - \frac{1}{24} = \frac{1}{24}
\]

- Second part:

\[
\left[6x^2 - x \right]_{1/12}^{1/6} = \left(6 \left(\frac{1}{6}\right)^2 - \frac{1}{6} \right) - \left(6

$$
\left(\frac{1}{12}\right)^2 - \frac{1}{12} \right)
$$

Calculations:

$$
6 \cdot \frac{1}{36} - \frac{1}{6} = \frac{6}{36} - \frac{1}{6} = \frac{1}{6} - \frac{1}{6} = 0
$$

$$
6 \cdot \frac{1}{144} - \frac{1}{12} = \frac{6}{144} - \frac{1}{12} = \frac{1}{24} - \frac{1}{12} = \frac{1}{24} - \frac{2}{24} = -\frac{1}{24}
$$

Adding both parts:

$$
\frac{1}{24} + 0 - (-\frac{1}{24}) = \frac{1}{24} + \frac{1}{24} = \frac{2}{24} = \frac{1}{12}
$$

Thus,

$$
\int_{0}^{\frac{1}{6}} |12x - 1|\, dx = \frac{1}{12}
$$

Applications and Broader Implications

Real-world contexts

- Physics: Calculating work done over a distance when the direction of motion changes.
- Economics: Modeling profit/loss functions that switch signs at certain thresholds.
- Engineering: Signal processing where the absolute value of a linear function describes magnitude.

Pedagogical importance

Understanding how to evaluate integrals involving absolute values enhances problem-solving skills, especially in handling piecewise functions and integrating functions with variable sign behavior.

Common Pitfalls and How to Avoid Them

- Neglecting the critical point: Always find where the expression inside the absolute value equals zero.
- Incorrectly splitting the integral: Ensure the limits are correctly partitioned based on the critical point.
- Misapplying the signs: Remember that $|ax + b|$ becomes $-(ax + b)$ where $ax + b < 0$.

Summary of the General Approach

1. Identify the critical point(s): Solve \(ax + b = 0\).
2. Determine the sign of the expression on each interval.
3. Express the integral as a sum of integrals over each interval, with the integrand replaced by the appropriate linear function.
4. Integrate each piece separately, using standard power rule techniques.
5. Combine results, adding constants of integration or evaluating definite integrals as needed.

Final Reflection: The Result of the

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