Give The Exact Value Of This Expression. 55 COS Sin 3 -1 + Cot-1 17. Find This Power And Write Your Answer

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Introduction

Understanding and evaluating complex mathematical expressions is fundamental in advanced mathematics, especially in trigonometry and algebra. Expressions involving multiple trigonometric functions, inverse functions, and powers often appear in various mathematical contexts, including calculus, physics, and engineering.

In this article, we will delve into the detailed process of finding the exact value of the given expression:

$$ 55 \cos \sin 3 - 1 + \cot^{-1} 17 $$

We will analyze each component carefully, clarify the notation, and compute the overall value with clear explanations. By the end of this guide, you'll be equipped not only to evaluate this specific expression but also to understand similar complex trigonometric expressions.

Clarifying the Expression

Before diving into calculations, it is essential to interpret the expression correctly. The expression given is:

$$ 55 \cos \sin 3 - 1 + \cot^{-1} 17 $$

Possible Interpretations

Due to the ambiguous notation, there are two common interpretations:

1. Interpretation 1:

$$ 55 \times \cos(\sin 3) - 1 + \cot^{-1} 17 $$

2. Interpretation 2:

$$ (55 \times \cos \sin 3) - 1 + \cot^{-1} 17 $$

Given the context and common mathematical conventions, the most plausible interpretation is:

\[55 \times \cos(\sin 3) - 1 + \cot^{-1} 17 \]

where:

- \(\sin 3\) is the sine of 3 radians,
- \(\cot^{-1} 17\) is the inverse cotangent (arccotangent) of 17.

Assumption

For the purposes of this article, we will assume the expression is:

\[
\boxed{
E = 55 \times \cos (\sin 3) - 1 + \cot^{-1} 17
}
\]

Step-by-Step Evaluation

To compute \(E\), we will evaluate each term separately:

- \(\sin 3 \)
- \(\cos (\sin 3) \)
- \(\cot^{-1} 17 \)

and then combine the results as per the expression.

Evaluating \(\sin 3\)

Understanding \(\sin 3\)

Since the argument 3 is in radians (the standard in most mathematical contexts unless specified otherwise), we calculate:

\[
\sin 3 \text{ radians}
\]

Using a calculator or computational tools:

\[
\sin 3 \approx 0.1411200
\]

Significance

This value is the sine of 3 radians, roughly 0.1411. It will serve as the input for the cosine function.

Calculating $\cos (\sin 3)$

Given $\sin 3 \approx 0.1411200$, we now find:

$$
\cos (0.1411200)
$$

Using a calculator:

$$
\cos 0.1411200 \approx 0.9899
$$

This is a key intermediate value for the main expression.

Computing $55 \times \cos (\sin 3)$

Multiplying:

$$
55 \times 0.9899 \approx 54.4445
$$

This is the first major term in the expression.

Evaluating $\cot^{-1} 17$

Understanding $\cot^{-1} 17$

The inverse cotangent function, $\cot^{-1} x$, gives the angle θ such that:

$$
\cot \theta = x
$$

Alternatively, if you prefer, it is related to the inverse tangent function:

$$
\cot^{-1} x = \arctan \left(\frac{1}{x} \right)
$$

\]

for positive \(x\).

Computing \(\cot^{-1} 17\)

Since \(x = 17\):

\[
\cot^{-1} 17 = \arctan \left(\frac{1}{17} \right)
\]

Calculate:

\[
\arctan \left(\frac{1}{17} \right)
\]

Using a calculator:

\[
\arctan \left(\frac{1}{17} \right) \approx \arctan (0.0588235) \approx 0.05879 \text{ radians}
\]

Converting to degrees (optional)

\[
0.05879 \text{ radians} \times \frac{180}{\pi} \approx 3.366^\circ
\]

But for the purpose of exact evaluation, we will keep the value in radians.

Final Assembly of the Expression

Now, sum all parts:

\[
E = 54.4445 - 1 + 0.05879
\]

Calculate:

\[
54.4445 - 1 = 53.4445
\]
\[
53.4445 + 0.05879 \approx 53.50329
\]

Thus, the approximate value of the expression is:

$$
\boxed{
E \approx 53.5033
}
$$

Exact Value Considerations

While the above calculations provide a numerical approximation, the problem asks for the exact value of the expression.

Is it possible to express the exact value?

- $\sin 3$ is an irrational number, and $\cos (\sin 3)$ is transcendental.
- $\cot^{-1} 17$ is expressible as $\arctan(1/17)$, which is irrational unless for special angles.

Therefore, the exact value involves transcendental and irrational numbers; it cannot be simplified further into elementary exact expressions.

Hence, the exact value of the expression in terms of standard functions is:

$$
\boxed{
E = 55 \times \cos (\sin 3) - 1 + \arctan \left(\frac{1}{17} \right)
}
$$

Additional Insights

Why the expression's value is approximately 53.5

- The dominant term is $55 \times \cos (\sin 3)$, which is close to 55 since $\cos (\sin 3) \approx 0.9899$.
- The subtraction of 1 reduces this to about 54.44.
- The addition of $\cot^{-1} 17$, approximately 0.05879, slightly increases the total, resulting in roughly 53.5033.

Applications of Such Calculations

These types of calculations are common in:

- Advanced trigonometry: understanding the behavior of composite functions.
- Physics: calculating angles and ratios in wave mechanics.
- Engineering: signal processing where phase angles involve inverse trigonometric

functions.
- Mathematical analysis: approximating transcendental functions' behavior.

Summary

To summarize, evaluating the expression:

$$
55 \cos (\sin 3) - 1 + \cot^{-1} 17
$$

entails:

1. Computing $\sin 3$ radians, approximately 0.1411.
2. Finding $\cos (\sin 3)$, approximately 0.9899.
3. Multiplying by 55 to get about 54.4445.
4. Calculating $\cot^{-1} 17 = \arctan(1/17)$, approximately 0.05879 radians.
5. Combining these to approximate the total as about 53.5033.

The exact value remains expressed in terms of inverse trigonometric functions and transcendental quantities, emphasizing the richness and complexity of such mathematical expressions.

Final Remarks

Understanding how to evaluate complex trigonometric expressions requires familiarity with function properties, calculator accuracy, and sometimes, approximation methods. Always verify whether the angles are in radians or degrees, as this impacts the calculations significantly.

If you seek more precise evaluations, consider using high-precision computational tools or software such as WolframAlpha, MATLAB, or Python with libraries like NumPy or SymPy. These can handle symbolic expressions and high-precision calculations effectively.

Frequently Asked Questions (FAQs)

Q1: Can the exact value of $\cot^{-1} 17$ be expressed in a simple radical form?

A: No. $\cot^{-1} 17 = \arctan \left(\frac{1}{17} \right)$, which is transcendental and cannot be simplified into radical expressions. Its value is best represented as an inverse tangent function.

Q2: Is $\sin 3$ in degrees or radians?

A: In most mathematical contexts, unless specified, angles are in radians. Since 3 is a relatively small number, it is most consistent to assume radians.

Q3: How can I improve the accuracy of such calculations?

A: Use high-precision calculators, computational software, or programming languages with arbitrary precision libraries. Always specify the angle units and check your calculator's mode.

Conclusion

Evaluating complex trigonometric expressions combines analytical understanding and computational skills. While some parts can be approximated numerically, the exact value often remains expressed in terms of special functions like

Frequently Asked Questions

What is the exact value of the expression 55 cos sin 3 - 1 + $\cot^{-1}$ 17?

The expression as given is ambiguous; assuming it means $55 \times \cos(3) \times \sin(3) - 1 + \cot^{-1}(17)$. Calculating cos(3) and sin(3) (assuming angles in radians): $\cos(3) \approx -0.9899$, $\sin(3) \approx 0.1411$. Then $55 \times (-0.9899) \times 0.1411 \approx 55 \times (-0.1398) \approx -7.688$. Next, $\cot^{-1}(17)$ is the inverse cotangent of 17, which is approximately 0.057 radians. Summing up: $-7.688 - 1 + 0.057 \approx -8.631$. Therefore, the exact value is approximately -8.631.

How do you evaluate $\cot^{-1}$ 17 in the given expression?

$\cot^{-1}$ 17 is the inverse cotangent of 17, which gives the angle whose cotangent is 17. Since cotangent is adjacent over opposite, this angle is very small, approximately 0.057 radians or about 3.28 degrees.

What assumptions are made about the angles in the expression?

It is assumed that the angles are in radians unless specified otherwise, which affects the calculation of cos(3) and sin(3).

Can the expression be simplified further?

Yes, by calculating the individual parts accurately and combining them. If the angles are in degrees, the values would differ, so clarity on the angle units is essential.

What is the significance of finding the exact value of such an expression?

Determining the exact value helps in precise calculations in trigonometry, especially in advanced mathematics and engineering applications where approximate values may not suffice.

How do inverse trigonometric functions like $\cot^{-1}$ affect the calculation?

Inverse functions give the measure of the angle corresponding to a specific ratio. Calculating $\cot^{-1}(17)$ involves finding an angle whose cotangent is 17, which can be approximated using calculators or known identities.

What tools can be used to evaluate such expressions accurately?

Scientific calculators, mathematical software like WolframAlpha, or programming languages with math libraries (e.g., Python, MATLAB) can be used for precise computation.

Why is it important to specify the units of angles in trigonometric problems?

Because the values of sine, cosine, and inverse functions depend on whether angles are measured in degrees or radians, which affects the accuracy of the calculation.

Is the expression meant to be simplified or to find a numerical approximation?

Typically, such expressions are simplified to an exact value if possible or approximated numerically if the exact form is complex; clarification depends on the context of the problem.

Additional Resources

Give The Exact Value Of This Expression. 55 COS Sin 3 -1 + Cot-1 17. Find This Power And Write Your Answer is a complex mathematical problem that combines various trigonometric functions, inverse functions, and algebraic manipulations. Such problems are designed to test not only one's knowledge of fundamental trigonometry but also the ability to apply various identities and transformations systematically. In this comprehensive review, we will analyze the problem step-by-step, explore relevant concepts, and demonstrate how to arrive at an exact value for the given expression. This article aims to clarify the approach, decode the notation, and provide a detailed solution with insights into the underlying mathematical principles.

Understanding the Components of the Expression

Before diving into calculations, it is crucial to interpret the expression correctly. The expression in question appears to be:

55 cos sin 3 - 1 + cot-1 17

However, the notation is somewhat ambiguous and may benefit from clarification:

- "55 COS Sin 3 -1" likely refers to 55 × cos(sin(3)) - 1.
- "Cot-1 17" refers to the inverse cotangent (cot-1) of 17.

Therefore, the entire expression can be written more clearly as:

55 × cos(sin(3)) - 1 + cot-1(17)

where the angles are presumably in radians unless specified otherwise.

Breaking Down the Expression

The expression contains three main parts:

1. 55 × cos(sin(3)) - a composite function involving nested trigonometric functions.
2. -1 - a simple subtraction.
3. cot-1(17) - the inverse cotangent of 17.

Each part requires careful evaluation:

- Understanding and calculating cos(sin(3))
- Recognizing the value of cot-1(17)
- Combining all these to find the exact value.

Part 1: Evaluating 55 × cos(sin(3))

Step 1: Calculate sin(3)

Since the angle is in radians:

sin(3) ≈ 0.14112 (using a calculator)

Step 2: Calculate cos(sin(3))

Now, cos(sin(3)) = cos(0.14112)

cos(0.14112) ≈ 0.98997

Step 3: Multiply by 55

55 × 0.98997 ≈ 54.4484

Thus, the first part of the expression evaluates approximately to 54.4484.

Part 2: The constant -1

Adding this:

54.4484 - 1 = 53.4484

Part 3: Evaluating $\cot^{-1}(17)$

The inverse cotangent function, cot-1(x), gives the angle θ in radians such that cot θ = x.

Step 1: Understanding cot-1(17)

cot θ = 17

Since cot θ = 1 / tan θ, then:

tan θ = 1 / 17 ≈ 0.05882

Step 2: Find θ = cot-1(17)

Using a calculator:

θ = arctangent(0.05882) ≈ 0.05878 radians

Therefore:

cot-1(17) ≈ 0.05878 radians

Combining All Parts for the Final Result

Adding everything together:

Total = 54.4484 (from part 1) - 1 + 0.05878 (from part 3)

Total ≈ 54.4484 + 0.05878 - 1 ≈ 53.5072

Approximate value of the expression: 53.5072

Interpreting the Exact Value

While the approximate calculation yields about 53.5072, the question asks for the exact value.

Key considerations for exact evaluation:

- sin(3) is in radians and does not correspond to a well-known special angle, so sin(3) remains an irrational number.
- cos(sin(3)) then involves the cosine of an irrational number, resulting in an irrational number.
- cot-1(17) can be expressed exactly as arccot(17), which is an inverse cotangent in terms of the arctangent function:

arccot(17) = arctangent(1/17)

Thus, the exact expression can be written as:

55 × cos(sin(3)) - 1 + arctangent(1/17)

This expression involves known functions but does not simplify into a closed-form rational number or a common radical expression.

Alternative Approach: Expressing the Result in Terms of Inverse Functions

Given the complexity, an exact expression for the entire problem is:

E = 55 × cos(sin(3)) - 1 + arctangent(1/17)

This form maintains mathematical exactness without decimal approximation.

Features, Pros, and Cons of the Approach

Features:

- Uses fundamental trigonometric identities and inverse functions.
- Recognizes the importance of expressing answers in exact form when possible.
- Combines numerical approximation with symbolic representation.

Pros:

- Provides a clear step-by-step method to evaluate complex expressions.
- Demonstrates how to interpret ambiguous notation.
- Connects inverse cotangent to arctangent, facilitating exact expressions.

Cons:

- Some parts involve irrational numbers that cannot be simplified further.
- Numerical approximations are necessary for practical values but do not constitute the exact answer.
- Assumes angles are in radians; clarity on units could improve precision.

Conclusion

The problem "Give The Exact Value Of This Expression. 55 COS Sin 3 -1 + Cot-1 17" involves multiple layers of trigonometric and inverse functions. The key steps include evaluating the nested sine and cosine functions, recognizing the inverse cotangent in terms of arctangent, and combining these results systematically.

The exact value of the expression can be expressed as:

$E = 55 \times \cos(\sin(3)) - 1 + \text{arctangent}(1/17)$

While the numerical approximation is approximately 53.5072, the exact form remains in terms of fundamental inverse functions, reflecting the inherent complexity of such problems. This approach underscores the importance of understanding both the numerical methods and symbolic representations in advanced trigonometry, empowering learners to handle similar problems with confidence.

Final Note: When solving intricate trigonometric expressions, always clarify the notation, work systematically through each component, and aim for exact symbolic expressions whenever possible. This not only enhances understanding but also preserves mathematical rigor.

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