What Value Of X Satisfies This Equation? 10(1.5)^3x = 80 Round Your Answer To The Nearest Hundredth. The

What Value Of X Satisfies This Equation? 10(1.5)^3x = 80 Round Your Answer To The Nearest Hundredth.

Understanding how to solve exponential equations is a fundamental skill in mathematics that can be applied across various fields, including science, engineering, finance, and technology. The equation 10(1.5)^3x = 80 presents an interesting challenge that involves isolating the variable x within an exponential expression. In this article, we will walk through the steps necessary to find the value of x that satisfies this equation, explain the concepts involved, and provide tips for solving similar problems efficiently.

Breaking Down the Equation

Before diving into the solution, it's essential to understand the structure of the equation:

10(1.5)^3x = 80

This equation combines a constant coefficient (10), an exponential term (1.5)^3x, and an equality with a constant (80). Our goal is to solve for x, which appears in the exponent of the exponential expression.

Step 1: Isolate the Exponential Term

The first step is to isolate the exponential term on one side of the equation:

- Divide both sides of the equation by 10 to isolate (1.5)^3x:

(1.5)^3x = 80 / 10

- Simplify the right side:

(1.5)^3x = 8

Step 2: Recognize the Exponential Expression

The equation now looks like:

(1.5)^3x = 8

Here, the exponential expression is (1.5)^3x, which can be rewritten for clarity:

(1.5)^{3x} = 8

It's important to note that the exponent is 3x, meaning the expression has the form a^{b x}.

Using Logarithms to Solve for X

Since the variable x is in the exponent, logarithms are a powerful tool for solving for x.

Step 3: Apply Logarithms to Both Sides

You can choose any logarithm base, but common choices are natural logs (ln) or log base 10 (log). Here, we'll use the natural logarithm for consistency:

- Take the natural logarithm of both sides:

$\ln[(1.5)^{3x}] = \ln(8)$

Step 4: Use Logarithmic Properties

Recall that:

$\ln(a^b) = b \ln(a)$

Applying this property:

$3x \ln(1.5) = \ln(8)$

Step 5: Solve for x

Now, isolate x:

$x = [\ln(8)] / [3 \ln(1.5)]$

Calculating the Numerical Value

Next, compute the values of the natural logarithms involved:

- $\ln(8)$
- $\ln(1.5)$

Using a calculator:

- $\ln(8) \approx 2.0794415$
- $\ln(1.5) \approx 0.4054651$

Plug these into the formula:

$x \approx 2.0794415 / (3\ 0.4054651)$

Calculate the denominator:

$3\ 0.4054651 \approx 1.2163953$

Finally, divide:

$x \approx 2.0794415 / 1.2163953 \approx 1.709$

Rounding to the Nearest Hundredth

The approximate value of x is 1.709. Rounded to the nearest hundredth:

$x \approx 1.71$

Summary of the Solution Steps

To recap, the process to solve the exponential equation $10(1.5)^{3x} = 80$ is as follows:

1. Divide both sides by 10 to isolate the exponential:

$(1.5)^{3x} = 8$

2. Take the natural logarithm of both sides:

$\ln[(1.5)^{3x}] = \ln(8)$

3. Apply the log power rule:

$3x \ln(1.5) = \ln(8)$

4. Solve for x:

$x = [\ln(8)] / [3 \ln(1.5)]$

5. Substitute the known logarithm values and compute:

$x \approx 1.71$

Additional Tips for Solving Similar Equations

- Always isolate the exponential term before applying logarithms.
- Choose the logarithm base that makes calculations easiest; natural logs (ln) are often preferred.
- Remember the logarithmic property: $\ln(a^b) = b \ln(a)$.
- Be careful with rounding during intermediate steps; perform calculations with sufficient precision.
- Use a calculator or computer algebra system to handle logarithms and divisions accurately.

Applications of Solving Exponential Equations

Understanding how to solve equations like $10(1.5)^{3x} = 80$ is critical in various practical contexts:

- Population Growth Models: Exponential functions model how populations grow or decline over time.
- Finance and Investment: Compound interest calculations often involve exponential equations.
- Radioactive Decay: Decay processes follow exponential laws, requiring similar solving techniques.
- Computer Science: Algorithms with exponential time complexity may be analyzed using these methods.

Conclusion

Mastering the process of solving exponential equations is an essential skill in mathematics that enables problem-solving across many disciplines. In the case of the equation 10(1.5)^3x = 80, we demonstrated how to isolate the exponential term, apply logarithms, and compute the value of x. The solution, rounded to the nearest hundredth, is approximately 1.71. Whether for academic purposes or real-world applications, understanding these steps equips you with a powerful tool for tackling similar problems confidently and accurately.

Frequently Asked Questions

What value of x satisfies the equation 10(1.5)^{3x} = 80?

x ≈ 0.58

How do you solve for x in the equation 10(1.5)^{3x} = 80?

Divide both sides by 10 to get (1.5)^{3x} = 8, then take natural logarithms: 3x ln(1.5) = ln(8). Solving for x gives x ≈ 0.58.

What is the step-by-step process to find x in 10(1.5)^{3x} = 80?

First, divide both sides by 10: (1.5)^{3x} = 8. Then, take the natural log of both sides: 3x ln(1.5) = ln(8). Next, solve for x: x = ln(8) / (3 ln(1.5)) ≈ 0.58.

Why do we use logarithms to solve for x in the equation 10(1.5)^{3x} = 80?

Because the variable x is in an exponent, taking logarithms allows us to bring the exponent down and solve for x algebraically.

What is the rounded value of x for the equation 10(1.5)^{3x} = 80?

x ≈ 0.58 when rounded to the nearest hundredth.

Can the value of x be negative in the equation 10(1.5)^{3x} = 80? Why or why not?

Yes, x can be negative; it depends on the specific solution. In this case, x ≈ 0.58, which is positive, but the method applies regardless of whether x is positive or negative.

Additional Resources

Understanding Exponential Equations: Solving for X in 10(1.5)^{3x} = 80

When delving into the world of algebra, exponential equations often seem complex and intimidating. However, with a systematic approach, these equations become manageable and solvable. Today, we're exploring a specific exponential equation:

10(1.5)^{3x} = 80

Our goal is to find the value of x that satisfies this equation, rounding the answer to the nearest hundredth. To do this effectively, we'll break down the problem into digestible steps, explaining each concept along the way. Think of this as a detailed product review where each feature (or step) is examined carefully.

Decoding the Equation: What Are We Dealing With?

Before jumping into calculations, it's essential to understand the components of the equation:

- Coefficient (10): A constant multiplier that scales the exponential term.
- Exponential Term $(1.5)^{3x}$: The core of the equation, where the variable x appears in the exponent.
- Right Side (80): The value that the expression on the left must equal.

This equation belongs to the class of exponential equations, characterized by variables in the exponent. These are common in fields like finance (compound interest), population dynamics, and radioactive decay, making mastery over them invaluable.

Step 1: Isolate the Exponential Expression

The first step is to isolate the exponential component $(1.5)^{3x}$. Currently, it's multiplied by 10:

$$
10(1.5)^{3x} = 80
$$

Dividing both sides of the equation by 10 simplifies the expression:

$$
(1.5)^{3x} = \frac{80}{10} = 8
$$

This step is crucial because it transforms the equation into a more manageable form, setting us up for the application of logarithms.

Step 2: Applying Logarithms to Solve for the Variable

Exponential equations with variables in the exponent are most effectively tackled using logarithms, which "bring down" the exponent and allow us to solve for the variable explicitly.

Why logarithms? Because they are inverse functions of exponentials. The key property used here is:

$$
a^{k} = b \implies \log_a b = k
$$

However, since the base a (which is 1.5) may not be convenient for direct logarithm calculations, we often use the natural logarithm (ln) or common logarithm (log base 10). The change of base formula allows flexibility:

$$
a^{k} = b \implies k = \frac{\log b}{\log a}
$$

In our case, the equation becomes:

$$
(1.5)^{3x} = 8
$$

Applying logarithms to both sides:

$$
\log \left((1.5)^{3x} \right) = \log 8
$$

Using the logarithmic power rule:

$$
3x \cdot \log 1.5 = \log 8
$$

This is a pivotal step, as it transforms the exponential equation into a linear form in terms of x.

Step 3: Solving for x

Now, isolate x:

$$
3x \cdot \log 1.5 = \log 8
$$

Divide both sides by $3 \cdot \log 1.5$:

$$
x = \frac{\log 8}{3 \cdot \log 1.5}
$$

At this stage, we perform the actual calculations. Using common logarithms (base 10):

- $\log 8$
- $\log 1.5$

Calculations:

$$
\log 8 \approx 0.90309
$$

$$
\log 1.5 \approx 0.17609
$$

Now, plug these into the formula:

$$
x = \frac{0.90309}{3 \times 0.17609} = \frac{0.90309}{0.52827}
$$

Divide:

$$
x \approx 1.708
$$

Rounding to the nearest hundredth:

$$
x \approx \boxed{1.71}
$$

Summary of the Calculation Process

1. Isolate the exponential term: Divide both sides by 10.
2. Apply logarithms: Use the logarithmic property to bring down the exponent.
3. Solve for x: Divide through by the coefficient involving the logarithm.
4. Calculate and round: Use a calculator for precise logarithmic values, then round appropriately.

Key Takeaways and Tips for Solving Similar Equations

- Always isolate the exponential expression first: This simplifies the problem and makes applying logarithms straightforward.
- Choose the appropriate logarithm base: Natural logs or common logs work equally well, but consistency is key.
- Remember the logarithmic properties:

- $\log(a^k) = k \cdot \log a$

- Change of base formula: $\log_a b = \frac{\log b}{\log a}$

- Use calculator precision: Ensure your calculator is set correctly, and record values accurately.
- Round at the end: To maintain accuracy, perform all calculations first, then round.

Real-World Applications of Such Calculations

Understanding how to solve equations like $10(1.5)^{3x} = 80$ isn't just an academic exercise. These calculations are fundamental in:

- Finance: Calculating compound interest over time with variable rates.
- Biology: Modeling population growth with exponential functions.
- Physics: Radioactive decay and half-life calculations.

- Statistics: Logarithmic transformations in data analysis.

Mastering these techniques equips you with a powerful tool for interpreting real-world phenomena that follow exponential patterns.

Final Thoughts

In conclusion, solving for x in the equation 10(1.5)^{3x} = 80 involves:

- Isolating the exponential term.
- Applying logarithms to linearize the exponential.
- Using logarithmic properties to solve for x.
- Performing precise calculations and rounding appropriately.

Your final answer, rounded to the nearest hundredth, is:

$$
\boxed{1.71}
$$

This process exemplifies the elegance and practicality of logarithmic methods in algebra, transforming complex exponential equations into straightforward calculations. With practice, you'll find these techniques become second nature, empowering you to solve a wide array of mathematical challenges confidently.

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