

Simplify: $3[(7 - 5)^2 + (20 - 19)^2] + 14$

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Understanding how to simplify complex algebraic expressions is a fundamental skill in mathematics that enhances problem-solving skills and critical thinking. In this article, we will explore the step-by-step process of simplifying the expression:

Simplify: $3[(7 - 5)^2 + (20 - 19)^2] + 14$

By breaking down the expression into manageable parts, you can develop a clear approach to tackling similar algebraic problems, whether for schoolwork, exams, or real-world applications.

Breaking Down the Expression

The expression to simplify is:

$3[(7 - 5)^2 + (20 - 19)^2] + 14$

Before diving into calculations, it's essential to understand the order of operations, often remembered by the acronym PEMDAS (Parentheses, Exponents, Multiplication and Division, Addition and Subtraction).

Key steps:

1. Simplify expressions inside parentheses.
2. Perform multiplication and division.
3. Carry out addition and subtraction.

Let's apply these principles systematically to the expression.

Step-by-Step Simplification Process

Step 1: Simplify Inside Parentheses

Within the brackets, we have two main parts:

- $(7 - 5)$
- $(20 - 19)$

Calculating these:

- $(7 - 5) = 2$
- $(20 - 19) = 1$

Now, the expression becomes:

$$3[(2) 2 + (1) 2] + 14$$

Step 2: Perform Multiplication

Next, multiply the results:

- $(2) 2 = 2 \times 2 = 4$
- $(1) 2 = 1 \times 2 = 2$

Now, the expression simplifies to:

$$3[4 + 2] + 14$$

Step 3: Simplify Inside the Brackets

Add the terms within the brackets:

$$4 + 2 = 6$$

The expression now becomes:

$$3 \times 6 + 14$$

Step 4: Final Multiplication and Addition

Multiply:

$$3 \times 6 = 18$$

Then, add 14:

$$18 + 14 = 32$$

Final simplified value: 32

Understanding the Order of Operations

To confidently simplify similar expressions, mastering the order of operations is crucial. Here's a quick review:

PEMDAS Breakdown:

- Parentheses: Simplify expressions inside parentheses first.
- Exponents: Calculate powers and roots.
- Multiplication and Division: Perform from left to right.
- Addition and Subtraction: Perform from left to right.

Applying PEMDAS ensures consistency and correctness in solving algebraic expressions.

Common Mistakes to Avoid

While simplifying expressions, certain errors can occur if careful attention isn't paid. Here are some pitfalls to watch out for:

1. Ignoring Parentheses

Always complete calculations inside parentheses first. Skipping this step leads to incorrect results.

2. Wrong Order of Operations

Perform multiplication before addition unless parentheses specify otherwise.

3. Miscalculating Basic Operations

Double-check arithmetic, especially multiplication and subtraction, to avoid simple mistakes.

4. Overlooking Negative Signs

Be cautious with negative numbers and signs, particularly in more complex expressions.

Practice Problems for Mastery

Enhance your skills by practicing similar problems. Here are some exercises:

Problem 1:

Simplify: $4[(6 - 2) 3 + (15 - 10) 2] + 8$

Problem 2:

Simplify: $2[(9 - 4) 5 + (12 - 8) 3] + 5$

Problem 3:

Simplify: $5[(8 - 3) 2 + (25 - 20) 4] + 10$

Try solving these step-by-step, following the same approach outlined above.

Real-World Applications of Simplifying Expressions

Simplifying algebraic expressions isn't just an academic exercise; it has practical applications in various fields:

Financial Calculations

- Calculating interest rates
- Budget planning
- Loan amortization

Engineering

- Structural analysis
- Signal processing

Computer Science

- Algorithm optimization
- Data analysis

Scientific Research

- Data modeling
- Experimental analysis

Mastering the skill of simplifying expressions enhances efficiency and accuracy across these disciplines.

Conclusion: The Power of Simplification

In this comprehensive guide, we've demonstrated how to simplify the expression:

Simplify: $3[(7 - 5)^2 + (20 - 19)^2] + 14$

by systematically applying the order of operations. The final answer is 32.

Remember, the key to mastering algebraic expressions lies in breaking down complex problems into smaller, manageable parts, and following the rules of PEMDAS diligently. With practice, you'll become more confident and efficient at simplifying even the most intricate expressions. Whether you're preparing for exams, solving real-world problems, or enhancing your mathematical understanding, these skills are invaluable assets in your problem-solving toolkit.

Additional Resources for Learning Algebra

To further improve your algebra skills, consider exploring:

- Online tutorials and videos
- Practice worksheets
- Algebra textbooks and guides
- Tutoring or study groups

Consistent practice and application will reinforce your understanding and make simplifying expressions second nature.

Final Thoughts

Simplification is a foundational concept in mathematics that unlocks the door to more advanced topics. By mastering the process demonstrated here, you'll develop critical thinking and problem-solving skills that extend beyond algebra. Continue practicing with various expressions, and you'll find that simplifying complex problems becomes an intuitive and rewarding process.

Remember: Take your time, follow the order of operations, and verify each

step for accuracy. Happy simplifying!

Frequently Asked Questions

What is the simplified form of the expression $3[(7 - 5)^2 + (20 - 19)^2] + 14$?

The simplified result is 20.

How do you evaluate the expression $3[(7 - 5)^2 + (20 - 19)^2] + 14$ step-by-step?

First, compute inside parentheses: $(7 - 5) = 2$ and $(20 - 19) = 1$. Then multiply: $2^2 = 4$ and $1^2 = 1$. Sum inside brackets: $4 + 1 = 5$. Multiply by 3: $3 \times 5 = 15$. Finally, add 14: $15 + 14 = 29$.

What is the order of operations used to simplify the expression $3[(7 - 5)^2 + (20 - 19)^2] + 14$?

The order is parentheses first, then multiplication, followed by addition inside brackets, then multiplication outside, and finally addition at the end.

Can this expression be simplified without using parentheses, and how?

Yes, by applying the order of operations directly: evaluate subtractions, then multiplications, then addition, following PEMDAS rules, which leads to the same final result.

What common mistakes should be avoided when simplifying this expression?

Avoid ignoring the parentheses, mixing up the order of operations, and forgetting to multiply after computing the differences inside parentheses.

What is the significance of simplifying expressions like this in math?

Simplifying expressions helps in understanding the problem better, reduces errors, and makes calculations more efficient, especially in complex algebraic problems.

Additional Resources

Mathematical Simplification

Introduction

Mathematics is often regarded as the language of logic, precision, and clarity. In particular, the process of simplification—reducing complex expressions into their most straightforward form—is a fundamental skill that underpins everything from basic arithmetic to advanced calculus. Today, we will explore a detailed, step-by-step simplification of the expression:

Simplify: $3[(7 - 5)^2 + (20 - 19)^2] + 14$

This expression might seem straightforward at first glance, but it encompasses various core concepts such as the order of operations, parentheses handling, and algebraic manipulations. By dissecting this expression comprehensively, we aim to demonstrate not only the procedure but also the importance of systematic reasoning in mathematical problem-solving.

Understanding the Expression

Before diving into calculations, it's essential to understand the structure of the expression:

$3[(7 - 5)^2 + (20 - 19)^2] + 14$

This expression involves:

- Multiple nested parentheses
- Multiplication operations
- Addition operations
- A constant term outside the brackets

Our goal is to simplify this entire expression to a single numerical value, revealing its most reduced form.

Dissecting the Expression

The expression can be broken down into parts for clarity:

1. Innermost parentheses: $(7 - 5)$ and $(20 - 19)$
2. Multiplications: $(7 - 5)^2$ and $(20 - 19)^2$

3. Addition within brackets: Sum of the two products
4. Multiplication outside brackets: Multiply the sum by 3
5. Final addition: Add 14 to the product

This layered approach ensures each step is manageable, minimizes errors, and aligns with the order of operations—often remembered by the acronym PEMDAS (Parentheses, Exponents, Multiplication and Division, Addition and Subtraction).

Step-by-Step Simplification

Let's proceed systematically.

Step 1: Simplify Innermost Parentheses

Identify the simplest components within the parentheses:

- $(7 - 5)$
- $(20 - 19)$

Calculations:

- $(7 - 5) = 2$
- $(20 - 19) = 1$

These are straightforward subtractions, fundamental building blocks in arithmetic.

Step 2: Handle Multiplications

Next, multiply these results by 2:

- $(7 - 5) \times 2$ becomes $2 \times 2 = 4$
- $(20 - 19) \times 2$ becomes $1 \times 2 = 2$

Multiplication takes precedence after parentheses, so we perform these calculations directly.

Step 3: Sum the Products Inside the Brackets

Now, sum the two products:

- $4 + 2 = 6$

This step consolidates the inner calculations into a single value, simplifying the expression significantly.

Step 4: Multiply the Sum by 3

Multiply the sum within the brackets by 3:

- $3 \times 6 = 18$

This is the next level of the expression, bringing us closer to the final value.

Step 5: Add the Constant Term 14

Finally, add 14 to the result:

- $18 + 14 = 32$

This completes the simplification process, yielding the most reduced form of the original expression.

Summary of the Simplification Process

Step	Operation	Result	Explanation
1	$(7 - 5)$	2	Subtracting within parentheses
2	$(20 - 19)$	1	Subtracting within parentheses
3	2×2	4	Multiplying $(7 - 5)$ result by 2
4	1×2	2	Multiplying $(20 - 19)$ result by 2
5	$4 + 2$	6	Summing the products inside brackets
6	3×6	18	Multiplying the sum by 3
7	$18 + 14$	32	Adding the constant term

The ultimate simplified value: 32

Conceptual Insights and Best Practices

1. Systematic Approach

Breaking down complex expressions into smaller, manageable parts ensures accuracy and clarity. Always start with innermost parentheses, then handle multiplication/division, then addition/subtraction.

2. Remembering PEMDAS

Order matters. Misordering operations can lead to incorrect results, especially in more complex expressions.

3. Verification

After each step, verify calculations—particularly with multi-step operations—to prevent compounding errors.

4. Using List Structures

Writing out steps in list or table formats (like above) helps visualize the process and catch mistakes early.

Real-World Applications of Simplification

While this example is purely mathematical, the skill of simplifying expressions is invaluable across various fields:

- Engineering: Calculating load distributions or electrical circuits.
- Finance: Simplifying formulas for interest calculations or investment returns.
- Computer Science: Optimizing algorithms by reducing complex expressions.
- Data Analysis: Cleaning and transforming data through algebraic manipulations.

Mastering such techniques extends beyond academia, fostering critical thinking and analytical skills vital in the professional world.

Conclusion

The journey of simplifying the expression $3[(7 - 5)^2 + (20 - 19)^2] + 14$ reveals much about the elegance of mathematical reasoning. By systematically applying the order of operations, handling parentheses first, then multiplication, and finally addition, we distilled a seemingly complex problem into a simple, elegant answer: 32.

This process exemplifies the importance of clarity, organization, and methodical thinking—traits that serve well in both academic and real-world problem-solving scenarios. Whether you're tackling algebra, calculus, or applied sciences, the principles demonstrated here form the foundation of effective analytical work.

Final note: Practice these principles regularly to develop fluency in simplifying expressions, enabling you to approach even more complex problems with confidence and precision.

Simplify 3 7 5 2 20 19 2 14

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