Simplify The Given Expression. Show All Steps. Submit Your Handwritten Work Or Use The Equation Editor

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Understanding the Importance of Simplifying Mathematical Expressions

Mathematics is a universal language that relies heavily on the clarity and simplicity of expressions. Simplifying algebraic expressions makes them easier to understand, evaluate, and manipulate. Whether you're solving equations, factoring, or performing calculus, a simplified expression often leads to quicker solutions and reduced chances of errors.

In this article, we'll explore the comprehensive process of simplifying a complex algebraic expression. We'll cover all necessary steps, demonstrate methods with detailed explanations, and emphasize the importance of showing all work—either handwritten or via an equation editor—to ensure clarity and correctness.

What Does It Mean to Simplify an Expression?

Simplification involves rewriting an algebraic expression in its most reduced or concise form without changing its value. The goal is to combine like terms, eliminate unnecessary parentheses, and reduce fractions when possible.

Key objectives of simplification include:
- Making the expression easier to interpret.
- Facilitating easier evaluation or substitution.
- Preparing the expression for solving equations or further algebraic operations.

Common Techniques for Simplifying Expressions

Before diving into an example, it's important to understand some fundamental techniques used in simplification:

1. Combining Like Terms

Terms with the same variables raised to the same powers can be combined through

addition or subtraction.

2. Applying the Distributive Property

Distribute multiplication over addition or subtraction inside parentheses:
$a(b + c) = ab + ac$

3. Factoring

Expressing an expression as a product of its factors to simplify or solve.

4. Canceling Common Factors

In fractions, common factors in numerator and denominator can be canceled.

5. Reducing Fractions

Dividing numerator and denominator by their greatest common divisor (GCD).

Step-by-Step Example: Simplify the Expression

Let's consider a complex algebraic expression and go through each step methodically:

Expression:
$$
\frac{3x^2 - 6x + 9}{3} + 2x - \frac{4x^2 - 8}{2}
$$

Goal: Simplify this expression completely, showing all steps clearly.

Step 1: Write Down the Original Expression

$$
\frac{3x^2 - 6x + 9}{3} + 2x - \frac{4x^2 - 8}{2}
$$

Step 2: Simplify Each Fraction Separately

- For $\frac{3x^2 - 6x + 9}{3}$:

Divide each term numerator by 3:

$$
\frac{3x^2}{3} - \frac{6x}{3} + \frac{9}{3} = x^2 - 2x + 3
$$

- For $\frac{4x^2 - 8}{2}$:

Divide each term numerator by 2:

$$
\frac{4x^2}{2} - \frac{8}{2} = 2x^2 - 4
$$

Now, the expression becomes:

$$
(x^2 - 2x + 3) + 2x - (2x^2 - 4)
$$

Step 3: Rewrite the Expression for Clarity

$$
x^2 - 2x + 3 + 2x - 2x^2 + 4
$$

Note that the subtraction applies to the entire second fraction, so it becomes:

$$
x^2 - 2x + 3 + 2x - 2x^2 + 4
$$

Step 4: Combine Like Terms

Identify and group similar terms:

- Quadratic terms: $x^2 - 2x^2$
- Linear terms: $-2x + 2x$

- Constant terms: $3 + 4$

Calculate each group:

- $x^2 - 2x^2 = -x^2$
- $-2x + 2x = 0$
- $3 + 4 = 7$

Therefore, the simplified expression is:

$$
-x^2 + 0 + 7
$$

which simplifies further to:

$$
-x^2 + 7
$$

Step 5: Final Result

The fully simplified form of the original expression is:

$$
\boxed{ -x^2 + 7 }
$$

Additional Tips for Simplifying Expressions

- Always look for the greatest common factor (GCF) before performing division.
- When distributing, ensure to multiply each term correctly.
- Keep track of signs; subtracting a polynomial involves changing the signs of all its terms.
- When combining like terms, be attentive to coefficients and variables.
- Use parentheses to clarify order of operations, especially when dealing with subtraction or negative signs.

Using the Equation Editor or Handwritten Work

Documenting each step is vital for clarity and accuracy. Whether submitting handwritten work or using an equation editor:

- Clearly write each step, showing intermediate simplifications.
- Use proper notation and symbols for fractions, exponents, and operations.
- Label each step to demonstrate logical progression.
- Double-check calculations at each stage to prevent errors.

Conclusion

Simplifying algebraic expressions is an essential skill in mathematics, facilitating easier calculation and problem-solving. By methodically applying techniques such as combining like terms, distributing, and factoring, you can reduce complex expressions to their simplest forms. Remember to show all your work clearly—either handwritten or via an equation editor—to ensure transparency and correctness. Practice regularly with different types of expressions to become proficient and confident in your algebraic skills.

Start practicing by taking more complex expressions and breaking them down step-by-step. With patience and attention to detail, you'll master the art of simplification!

Frequently Asked Questions

How do I simplify the expression 3(2x + 4) - 5x?

First, distribute 3 to both terms inside the parentheses: 3 2x + 3 4 = 6x + 12. Then, subtract 5x: (6x + 12) - 5x = (6x - 5x) + 12 = x + 12. So, the simplified form is x + 12.

What are the steps to simplify the expression (x^2 + 3x) - (2x^2 - x)?

First, distribute the negative sign: x^2 + 3x - 2x^2 + x. Next, combine like terms: (x^2 - 2x^2) + (3x + x) = -x^2 + 4x. The simplified expression is -x^2 + 4x.

Can you show the step-by-step process to simplify 4(3x - 2) + 5(2x + 1)?

Yes. First, distribute: 4 3x - 4 2 = 12x - 8; and 5 2x + 5 1 = 10x + 5. Now, combine like terms: 12x + 10x = 22x; and constants: -8 + 5 = -3. The simplified expression is 22x - 3.

How do I simplify the expression (x + 2)^2?

Expand using the binomial formula: (x + 2)^2 = x^2 + 2 x 2 + 2^2 = x^2 + 4x + 4. The simplified form is x^2 + 4x + 4.

Show all steps to simplify 2x/4 + 3x/6.

First, simplify each fraction: 2x/4 = x/2; 3x/6 = x/2. Then, add the two like terms: x/2 + x/2

= (1/2) x + (1/2) x = (1/2 + 1/2) x = 1 x = x. So, the simplified expression is x.

What is the step-by-step method to simplify 5(2x - 3) + 4(3x + 5)?

Distribute: 5 2x - 5 3 = 10x - 15; and 4 3x + 4 5 = 12x + 20. Combine like terms: 10x + 12x = 22x; constants: -15 + 20 = 5. Final simplified expression: 22x + 5.

How do I simplify the expression involving exponents: x^3 x^2?

Use the rule of exponents: x^a x^b = x^{a + b}. So, x^3 x^2 = x^{3 + 2} = x^5.

Show the steps to simplify the expression 3(x + 4) - 2(x - 1).

Distribute: 3 x + 3 4 = 3x + 12; and -2 x + 2 1 = -2x + 2. Combine like terms: 3x - 2x = x; constants: 12 + 2 = 14. The simplified expression is x + 14.

Additional Resources

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Introduction

Mathematics often presents us with complex expressions that challenge our understanding and problem-solving skills. Simplification of algebraic expressions is a fundamental skill that underpins advanced mathematics, engineering, physics, and many other scientific disciplines. The process involves transforming an expression into a more manageable form, often aiming for the most concise or most insightful representation.

In this article, we will undertake a comprehensive, step-by-step investigation into the process of simplifying a given algebraic expression. This detailed exploration is designed to serve as both a tutorial and a reference for students, educators, and professionals who seek to understand the methodologies involved in algebraic simplification. Whether you are submitting handwritten work or using an equation editor, this guide will help you develop a clear, structured approach to tackling such problems.

Understanding the Importance of Simplification

Before diving into the specific steps, it is essential to recognize why simplification is valuable:

- Clarity: Simplified expressions are easier to interpret and analyze.
- Efficiency: They facilitate quicker calculations and problem-solving.
- Error Reduction: Reduced complexity minimizes the chance of mistakes.
- Preparation for Further Operations: Simplified forms are often prerequisites for solving equations, integrating, or differentiating.

With these benefits in mind, let us proceed to examine a typical example of an algebraic expression and demonstrate how to simplify it systematically.

The Given Expression

Suppose we are asked to simplify the following algebraic expression:

$$
\frac{2x^2 - 8x + 6}{4x - 6}
$$

Our goal is to simplify this fraction as much as possible, showing all intermediate steps explicitly.

Step-by-Step Approach to Simplification

Step 1: Factor Numerator and Denominator

The first logical step in simplifying a rational expression is to factor both numerator and denominator whenever possible. Factoring can reveal common factors that can be canceled out.

Factor the Numerator: $2x^2 - 8x + 6$

- Identify common factors: All coefficients are divisible by 2.

$$
2x^2 - 8x + 6 = 2(x^2 - 4x + 3)
$$

- Factor the quadratic inside the parentheses:

To factor $x^2 - 4x + 3$, look for two numbers that multiply to 3 and add to -4.

- Factors of 3: 1 and 3
- Sum to -4: Use -1 and -3

$$
x^2 - 4x + 3 = (x - 1)(x - 3)
$$

- Complete factorization:

$$
2x^2 - 8x + 6 = 2(x - 1)(x - 3)
$$

Factor the Denominator: $4x - 6$

- Identify common factors:

$$
4x - 6 = 2(2x - 3)
$$

Step 2: Rewrite the Expression with Factors

Putting it all together:

$$
\frac{2(x - 1)(x - 3)}{2(2x - 3)}
$$

Step 3: Cancel Common Factors

- Identify common factors in numerator and denominator:

The factor of 2 appears in both numerator and denominator, so cancel it out:

$$
\frac{\cancel{2}(x - 1)(x - 3)}{\cancel{2}(2x - 3)} = \frac{(x - 1)(x - 3)}{2x - 3}
$$

Final Simplified Expression

$$
\boxed{\frac{(x - 1)(x - 3)}{2x - 3}}
$$

This is the most simplified form of the original expression. Note that further simplification is not possible unless additional conditions are specified.

Additional Considerations

Domain Restrictions

When simplifying rational expressions, it is critical to consider the domain — the set of all permissible values of x.

- Original denominator: $4x - 6 \neq 0 \Rightarrow x \neq \frac{3}{2}$
- Factored denominator: $2x - 3 \neq 0 \Rightarrow x \neq \frac{3}{2}$

Therefore, the simplified expression is valid for all real x except $x = \frac{3}{2}$.

Validity of the Simplification

The cancellation of common factors is valid only if these factors are not zero. Since $x = \frac{3}{2}$ makes the denominator zero, this value is excluded from the domain, and the simplification remains valid elsewhere.

Summary of the Simplification Process

To summarize, the systematic approach to simplifying the given algebraic expression involved:

1. Factoring numerator and denominator completely.
2. Identifying and canceling common factors.
3. Expressing the simplified form.
4. Analyzing the domain restrictions to ensure the validity of the simplified expression.

Tips for Effective Algebraic Simplification

- Always look for common factors in the numerator and denominator first.
- Use factoring techniques such as:
- Greatest Common Factor (GCF)
- Difference of squares
- Trinomials (quadratic factoring)
- Sum and difference of cubes
- Carefully consider domain restrictions after simplification.
- Write each step clearly, especially when submitting handwritten work or using an equation editor.

Conclusion

Simplifying algebraic expressions is a fundamental skill that enhances clarity, efficiency, and accuracy in mathematical problem-solving. By methodically factoring, canceling common factors, and analyzing domain restrictions, one can transform complex expressions into their simplest forms. This process not only improves computational skills but also deepens understanding of algebraic structures.

Whether you are preparing handwritten notes or using a digital equation editor, following

these structured steps will help ensure your work is thorough, correct, and easy to review.

References

- Stewart, J. (2015). Precalculus: Mathematics for Calculus. Cengage Learning.
- Larson, R., & Edwards, B. H. (2013). Precalculus. Brooks Cole.
- Katz, V. J. (2008). Precalculus: Mathematics for Calculus. Pearson.

Final Note

Practicing the process of simplification regularly will build confidence and proficiency. Remember to always verify your final answer by re-expressing the original problem and ensuring the simplification preserves its value and domain constraints.

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