6. Divide:6x+7x-2/3x-1using Long Division.

6. Divide: 6x + 7x - 2 / 3x - 1 using Long Division

Dividing polynomial expressions can seem challenging at first, but with a clear understanding of the process, it becomes a manageable and even enjoyable task. In this article, we will explore how to divide the algebraic expression (6x + 7x - 2) by (3x - 1) using the long division method. This method is fundamental in algebra, especially when simplifying complex rational expressions or solving polynomial equations. Whether you're a student learning algebra for the first time or someone looking to refresh your skills, this guide will provide a comprehensive walkthrough of polynomial long division with detailed explanations and examples.

Understanding the Polynomial Division Problem

Before diving into the step-by-step solution, it’s important to understand the problem at hand.

Breaking Down the Expression

The given expression is:

$(6x + 7x - 2) / (3x - 1)$

Notice that in the numerator, we have like terms 6x and 7x, which can be combined for simplicity:

$6x + 7x = 13x$

So, the simplified division problem becomes:

$(13x - 2) / (3x - 1)$

Our goal is to divide the polynomial numerator (13x - 2) by the polynomial denominator (3x - 1) using long division.

Why Use Long Division?

Long division of polynomials is analogous to numeric long division. It allows us to:

- Find the quotient polynomial
- Determine the remainder
- Express the division as a polynomial plus a fractional part if needed

This process is especially useful when dividing higher-degree polynomials or simplifying rational expressions.

Step-by-Step Guide to Polynomial Long Division

Let’s now walk through the division process step-by-step.

Step 1: Arrange the Polynomials

Ensure both the dividend (numerator) and divisor (denominator) are written in standard form, ordered descending by degree.

Dividend: $13x - 2$

Divisor: $3x - 1$

Since both are already in order, we can proceed.

Step 2: Divide the Leading Terms

Divide the leading term of the dividend by the leading term of the divisor:

- Leading term of dividend: $13x$
- Leading term of divisor: $3x$

Perform:

$13x \div 3x = 13/3$

This is a constant term (13/3), which will be our first term in the quotient.

Step 3: Multiply and Subtract

Multiply the divisor by this term:

$(3x - 1) (13/3) = (3x\ 13/3) - 1\ 13/3 = 13x - 13/3$

Now, subtract this from the current dividend:

$(13x - 2) - (13x - 13/3)$

Perform subtraction:

- $13x - 13x = 0$
- $-2 - (-13/3) = -2 + 13/3$

Convert -2 to thirds:

$-2 = -6/3$

Add:

$-6/3 + 13/3 = 7/3$

The new remainder after subtraction is 7/3.

Step 4: Bring Down and Repeat

Since the degree of the remainder (which is a constant term, degree 0) is less than the degree of the divisor (degree 1), the division process stops here.

The quotient is 13/3, and the remainder is 7/3.

Thus, the division can be expressed as:

$(13x - 2) / (3x - 1) = 13/3 + (7/3) / (3x - 1)$

Or, in a mixed form:

Quotient: 13/3

Remainder: 7/3

Final Expression:

$(13x - 2) / (3x - 1) = 13/3 + (7/3) / (3x - 1)$

which can be written as:

$(13x - 2) / (3x - 1) = 13/3 + (7/3)(1 / (3x - 1))$

This form is useful for understanding the division result, especially in calculus or algebraic contexts.

Additional Tips for Polynomial Long Division

To ensure accurate and efficient division, consider the following tips:

1. Always Arrange Polynomials Properly

Write both the dividend and divisor in standard descending order of degrees to avoid mistakes.

2. Be Careful with Coefficients and Signs

Pay close attention to signs (+ or -) during multiplication and subtraction steps.

3. Simplify at Each Step

Combine like terms immediately after subtraction to keep the process clear.

4. Check Your Work

Multiply the quotient by the divisor and add the remainder to verify if it equals the original dividend.

Common Mistakes to Avoid

While performing polynomial long division, students often encounter mistakes such as:

- Incorrectly dividing the leading terms
- Forgetting to multiply the divisor by the quotient term before subtraction
- Neglecting to update the dividend after subtraction
- Mismanaging signs during subtraction

Being meticulous and double-checking each step can help prevent these errors.

Practice Problems to Master Polynomial Long Division

To reinforce your understanding, try dividing these polynomials using long division:

1. $(8x^2 + 4x - 5) \div (2x + 1)$
2. $(5x^3 - 3x^2 + 2x - 7) \div (x - 2)$
3. $(9x^2 - 6x + 3) \div (3x - 1)$

For each problem, follow the steps outlined above, and verify your results by multiplying the quotient by the divisor and adding the remainder.

Applications of Polynomial Long Division

Polynomial division is more than just an academic exercise; it has practical applications in various fields:

- Simplifying rational expressions in algebra
- Finding asymptotes of rational functions in calculus
- Polynomial factorization and partial fraction decomposition
- Solving polynomial equations and inequalities

Understanding how to perform polynomial division using long division enhances your ability to manipulate and analyze complex algebraic expressions.

Conclusion

Dividing polynomials using long division may initially seem intimidating, but with a systematic approach, it becomes straightforward. The key steps involve arranging the polynomials properly, dividing the leading terms, multiplying back, subtracting, and repeating until the degree of the remainder is less than that of the divisor. Remember to pay attention to signs and coefficients throughout the process. Practice with different problems will improve your proficiency and confidence in handling polynomial division, an essential skill in algebra and higher mathematics.

By mastering this technique, you'll be well-equipped to tackle more advanced topics in mathematics, including calculus, algebraic fractions, and polynomial factorization. Keep practicing and refer back to these steps whenever you encounter polynomial division problems!

Frequently Asked Questions

How do I start dividing 6x + 7x - 2 by 3x - 1 using long division?

Begin by arranging the dividend (6x + 7x - 2) and the divisor (3x - 1) in long division format, then divide the leading term 6x by 3x, which gives 2. This is your first term of the quotient.

What is the first step in dividing (6x + 7x - 2) by (3x - 1) using long division?

The first step is to divide the leading term 6x of the dividend by the leading term 3x of the divisor, resulting in 2. Write 2 above the division bar.

How do I handle the subtraction step after multiplying 2 by

(3x - 1)?

Multiply 2 by (3x - 1) to get 6x - 2, then subtract this from the original dividend (6x + 7x - 2), which simplifies to (6x + 7x - 2) - (6x - 2) = 7x.

What do I do after subtracting to find the new remainder in the division?

After subtraction, bring down any remaining terms if applicable. In this case, the remainder is 7x. Then, divide the leading term of the new remainder (7x) by the leading term of the divisor (3x) to find the next quotient term.

How do I interpret the quotient obtained from dividing 6x + 7x - 2 by 3x - 1?

The quotient represents how many times the divisor fits into the dividend, which in this case is approximately 2 + (remaining terms)/divisor. The division process yields a simplified expression or a mixed expression if there's a remainder.

Can I simplify the expression (6x + 7x - 2) / (3x - 1) after division?

Yes, after performing long division, you can express the result as a quotient plus a fractional remainder or simplify further if the division yields a polynomial quotient without remainder.

What are common mistakes to avoid when dividing polynomials like 6x + 7x - 2 by 3x - 1?

Common mistakes include incorrectly dividing the leading terms, forgetting to multiply and subtract properly, and neglecting to reduce the remainder or misaligning terms during subtraction.

Is long division applicable for dividing polynomials like 6x + 7x - 2 by 3x - 1?

Yes, long division is a standard method for dividing polynomials, including linear and higher-degree expressions, to obtain quotient and remainder.

What is the final answer when dividing 6x + 7x - 2 by 3x - 1 using long division?

The division yields a quotient of 2 with a remainder of 7x + 2. So, the expression can be written as 2 + (7x + 2)/(3x - 1).

How can I verify my solution after performing long division on

these polynomials?

Multiply the quotient by the divisor and add the remainder; the result should equal the original dividend, confirming the accuracy of your division.

Additional Resources

Divide: 6x + 7x - 2 / 3x - 1 using Long Division is a fundamental algebraic operation that demonstrates the power and utility of polynomial division. This process is essential for students and mathematicians alike, as it offers insights into the structure of polynomials, simplifies complex expressions, and paves the way for solving higher-level algebraic problems. In this comprehensive review, we will explore the step-by-step procedure to divide the polynomial 6x + 7x - 2 by 3x - 1 using long division, discuss the features, benefits, and potential challenges of this method, and provide tips to master polynomial division effectively.

Understanding Polynomial Long Division

Before diving into the specific example, it is vital to understand what polynomial long division entails. Similar to numerical long division, polynomial division involves dividing a dividend polynomial by a divisor polynomial to find the quotient and potentially a remainder.

What Is Polynomial Long Division?

Polynomial long division is a systematic method used to divide one polynomial (the dividend) by another polynomial (the divisor), resulting in a quotient polynomial and a remainder polynomial. It is particularly useful when the degree of the dividend is greater than or equal to the degree of the divisor.

Why Use Long Division?

- Simplifies complex algebraic expressions.
- Essential in partial fraction decomposition.
- Helps in polynomial factorization.
- Used to find asymptotes or limits in calculus.

Step-by-Step Breakdown of the Division Process

Let’s analyze the specific example: dividing 6x + 7x - 2 by 3x - 1 using long division.

Note: First, combine like terms in the dividend:

6x + 7x - 2 = (6x + 7x) - 2 = 13x - 2

Our division problem is:

Divide: 13x - 2
By: 3x - 1

Step 1: Arrange the Polynomials

Write the dividend and divisor in standard form, ensuring all degrees are in descending order:

- Dividend: 13x - 2
- Divisor: 3x - 1

Step 2: Divide the Leading Terms

Divide the leading term of the dividend (13x) by the leading term of the divisor (3x):

13x ÷ 3x = 13/3

This is the first term of the quotient.

Step 3: Multiply and Subtract

Multiply the entire divisor by 13/3:

(3x - 1) (13/3) = 13x - 13/3

Now, subtract this from the current dividend:

(13x - 2) - (13x - 13/3)

Align terms:

13x - 2
- (13x - 13/3)

Perform subtraction:

13x - 13x = 0
-2 - (-13/3) = -2 + 13/3

Express -2 as a fraction with denominator 3:

-2 = -6/3

Now, sum:

-6/3 + 13/3 = 7/3

So, after subtraction, the new remainder is:

0 + 7/3 = 7/3

Step 4: Bring Down and Repeat

Since the degree of the remainder (which is constant, degree 0) is less than the degree of the divisor (degree 1), the division process stops here.

Final quotient: 13/3
Remainder: 7/3

Interpreting the Result

The division yields:

$$
\frac{13x - 2}{3x - 1} = \frac{13}{3} + \frac{7/3}{3x - 1}
$$

Or, expressed as a mixed form:

$$
\boxed{\frac{13}{3} + \frac{7/3}{3x - 1}}
$$

This indicates that the original rational expression simplifies to a constant plus a proper fraction.

Features and Advantages of Using Long Division in Polynomial Algebra

Long division is a robust tool in algebra, offering several features:

- Systematic Approach: Provides a clear, step-by-step method to divide polynomials.
- General Applicability: Works for any degree polynomial—linear, quadratic, or higher.
- Facilitates Polynomial Factoring: Essential in partial fraction decomposition and simplifying complex rational expressions.
- Insight into Polynomial Behavior: Reveals quotient and remainder, shedding light on polynomial relationships.

Pros:

- Highly reliable for exact division, especially when polynomials are factors.
- Helps in understanding the structure and degree of resulting expressions.
- Enhances algebraic manipulation skills.

Cons:

- Can be tedious with very high-degree polynomials.
- Prone to calculation errors if steps are not carefully followed.
- Less efficient compared to synthetic division when applicable.

Common Challenges and Tips for Mastery

While polynomial long division is straightforward conceptually, learners often encounter challenges:

- Handling Fractions: Dividing leading terms may produce fractional coefficients, which can complicate calculations.
- Order of Operations: Ensuring terms are aligned correctly during subtraction is critical.
- Sign Errors: Careful attention to signs (+ or -) prevents mistakes.

Tips to Overcome Challenges:

- Practice with simpler polynomials before progressing to complex ones.
- Write each step clearly and double-check calculations.
- Use fractions consistently to avoid miscalculations.
- Verify results by multiplying the quotient and divisor to see if you retrieve the original dividend.

Alternative Methods and When to Use Them

While long division is universal, sometimes alternative methods are more efficient:

- Synthetic Division: Best when dividing by a linear polynomial of the form x - a; not applicable here due to the divisor's form.
- Horner’s Method: Useful for evaluating polynomials but less direct for division.
- Factorization First: If possible, factor polynomials to simplify division or identify common factors.

When to choose long division:

- When the divisor is a polynomial of degree greater than 1.
- When straightforward division provides insight into the quotient and remainder.
- When other methods are not applicable or too cumbersome.

Conclusion: Mastering Polynomial Long Division

Dividing polynomials using long division, as demonstrated with 13x - 2 divided by 3x - 1, is an invaluable skill in algebra. It not only helps simplify complex expressions but also deepens understanding of polynomial relationships. Through systematic steps—arranging, dividing leading terms, multiplying, subtracting, and repeating—students can confidently navigate polynomial division. Mastery of this method opens doors to advanced topics such as calculus, algebraic factorization, and rational function analysis. While it may seem intricate initially, consistent practice, attention to detail, and understanding the underlying principles will ensure proficiency. Ultimately, polynomial long division remains an essential pillar of algebraic computation, empowering learners to tackle a wide range of mathematical challenges with confidence.

Features Summary:

- Enables exact division of polynomials of any degree.
- Clarifies the structure of rational expressions.
- Supports advanced algebraic applications.

Pros & Cons:

- Pros: Systematic, reliable, versatile.
- Cons: Time-consuming for high degrees, prone to minor errors.

Tips for Success:

- Practice with various polynomial divisions.
- Keep calculations organized.
- Use fractions carefully and verify results.

By mastering the division of 6x + 7x - 2 by 3x - 1 through long division, learners develop a foundational skill that enhances their overall algebraic competence and prepares them for more complex mathematical explorations.

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