Find The Value Of M If 2y+my+11y+m+3 Is Exadly Divisible By (2y-1)

Find The Value Of M If 2y+my+11y+m+3 Is Exadly Divisible By (2y-1) is a classic algebraic problem that involves understanding divisibility of polynomials and applying concepts like the Remainder Theorem. When faced with such problems, the key is to recognize that the divisibility of one polynomial by another often hinges on evaluating the polynomial at specific values of the variable, especially when the divisor is linear. In this case, the divisor (2y - 1) suggests that substituting y = 1/2 into the polynomial will reveal important information about the divisibility.

This article will guide you through the process of determining the value of M that makes the given polynomial divisible by (2y - 1). We will explore the foundational concepts, step-by-step calculations, and the reasoning behind each step to develop a comprehensive understanding of the problem.

Understanding the Problem

Before diving into calculations, it’s essential to clarify what the problem is asking:

- You are given a polynomial expression: 2y + my + 11y + m + 3.
- You need to find the value of M such that this polynomial is exactly divisible by the linear polynomial (2y - 1).

Key points:

- The polynomial is expressed in terms of y and M.
- Divisibility by (2y - 1) implies that when y is substituted with the root of (2y - 1) (which is y = 1/2), the polynomial should evaluate to zero.

This understanding stems from the Remainder Theorem, which states:

> If a polynomial f(y) is divisible by (y - a), then f(a) = 0.

In our case, since the divisor is (2y - 1), its root is y = 1/2. Therefore, plugging y = 1/2 into the polynomial should give zero if the polynomial is divisible by (2y - 1).

Step-by-Step Solution Approach

To find the value of M, follow these systematic steps:

Step 1: Simplify the Polynomial Expression

First, combine like terms in the polynomial:

Original polynomial: $2y + my + 11y + m + 3$

Combine the y-terms:

- $2y + 11y = 13y$
- my remains as is
- $m + 3$ are constant terms with respect to y

So, the simplified polynomial is:

$f(y) = (13y + my) + m + 3$

Factor y out from the y-terms:

$f(y) = y(13 + m) + m + 3$

This is a cleaner form to work with.

Step 2: Apply the Remainder Theorem

Since $(2y - 1)$ divides $f(y)$ exactly when $f(1/2) = 0$, substitute $y = 1/2$ into $f(y)$:

$f(1/2) = (1/2)(13 + m) + m + 3$

Calculate $f(1/2)$:

$f(1/2) = (1/2)(13 + m) + m + 3$

Expressed explicitly:

$f(1/2) = (13 + m)/2 + m + 3$

Step 3: Set the Expression Equal to Zero and Solve for M

For divisibility, $f(1/2)$ must be zero:

$(13 + m)/2 + m + 3 = 0$

Multiply both sides by 2 to clear the denominator:

$13 + m + 2m + 6 = 0$

Combine like terms:

$13 + 3m + 6 = 0$

Simplify:

(13 + 6) + 3m = 0

19 + 3m = 0

Now, solve for M:

3m = -19

m = -19/3

Therefore, the value of M is -19/3.

Conclusion

The process of determining the value of M hinges on understanding polynomial divisibility and applying the Remainder Theorem. By simplifying the given polynomial and evaluating it at the root of the divisor, we find that M must be -19/3 for the polynomial to be exactly divisible by (2y - 1).

Summary of key steps:

- Recognize the divisor's root (y = 1/2).
- Simplify the polynomial expression.
- Substitute y = 1/2 into the polynomial.
- Set the result equal to zero to satisfy divisibility.
- Solve for M.

This approach can be generalized to similar problems involving polynomial divisibility, making it a valuable technique in algebra. Whether you are solving for coefficients or testing divisibility conditions, understanding the Remainder Theorem and polynomial substitution remains fundamental.

Additional Tips for Solving Similar Problems

- Always identify the root of the divisor polynomial before substitution.
- Simplify expressions thoroughly before substitution to avoid calculation errors.
- Remember that divisibility conditions often lead to equations that can be solved for unknown parameters.
- Practice with different types of divisors (linear, quadratic) to strengthen your understanding of polynomial divisibility.

By mastering these concepts, you will be well-equipped to tackle a wide range of algebraic problems involving polynomial division and divisibility conditions.

In summary:

- The value of M that makes 2y + my + 11y + m + 3 exactly divisible by (2y - 1) is -19/3.
- This conclusion was reached through polynomial simplification, substitution based on the divisor's root, and solving the resulting equation.

Understanding these steps enhances your algebraic problem-solving skills and deepens your grasp of polynomial properties.

Frequently Asked Questions

What is the given expression in the problem?

The expression is 2y + my + 11y + m + 3.

What is the divisor in the divisibility condition?

The divisor is (2y - 1).

How can we determine the value of m using divisibility rules?

By applying the polynomial remainder theorem, setting y such that (2y - 1) equals zero, and ensuring the expression evaluates to zero at that y.

What is the value of y when the divisor (2y - 1) equals zero?

When 2y - 1 = 0, y = 1/2.

How do we substitute y = 1/2 into the expression to find m?

Replace y with 1/2 in the expression: 2(1/2) + m(1/2) + 11(1/2) + m + 3, and set the sum equal to zero for divisibility.

What is the simplified form after substitution to find m?

Simplify the expression: 1 + (m/2) + (11/2) + m + 3.

What is the value of m that makes the entire expression divisible by (2y - 1)?

Solving the simplified expression for zero gives m = -4.

Additional Resources

Find The Value Of M If 2y + my + 11y + m + 3 Is Exactly Divisible By (2y - 1)

When tackling algebraic divisibility problems, such as finding the value of M if 2y + my + 11y + m + 3 is exactly divisible by (2y - 1), it’s essential to approach the problem systematically. These types of problems often involve polynomial expressions where the goal is to determine specific parameter values (here, M) that satisfy divisibility conditions. Understanding the underlying principles—particularly the Remainder Theorem and polynomial factorization—can simplify the process considerably. In this comprehensive guide, we'll walk through the problem step-by-step, explore the relevant concepts, and demonstrate how to derive the value of M accurately.

Understanding the Problem

Let’s first restate the problem clearly:

> Find the value of M such that the polynomial expression (2y + my + 11y + m + 3) is exactly divisible by (2y - 1).

Key points:
- The polynomial is in terms of variables y and M.
- The divisor is a binomial: (2y - 1).
- The expression must be divisible by the divisor without remainder, meaning the polynomial evaluates to zero when divided by (2y - 1), or equivalently, when (2y - 1) is a factor, the polynomial should be divisible by it.

Step 1: Simplify the Polynomial Expression

The first step is to combine like terms in the polynomial expression:

$$ 2y + my + 11y + m + 3 $$

Group similar terms:

- Terms involving y: $2y + my + 11y = (2 + m + 11) y = (13 + m) y$
- Constant terms: $m + 3$

So, the simplified polynomial expression becomes:

P(y) = (13 + m) y + (m + 3)

Step 2: Recognize the Divisibility Condition

Since the polynomial $P(y)$ is divisible by $2y - 1$, the Remainder Theorem applies. The Remainder Theorem states that:

> For any polynomial $P(y)$, the remainder when divided by $(ay + b)$ is $P(-b/a)$.
> If $P(y)$ is divisible by $(ay + b)$, then $P(-b/a) = 0$.

In this case:

- $a = 2$
- $b = -1$

Therefore:

$$y_0 = -\frac{b}{a} = -\frac{-1}{2} = \frac{1}{2}$$

For divisibility, $P(y)$ must satisfy:

$$P\left(y = \frac{1}{2}\right) = 0$$

Step 3: Apply the Remainder Theorem

Plugging $y = \frac{1}{2}$ into the polynomial:

$$P\left(\frac{1}{2}\right) = (13 + m) \times \frac{1}{2} + (m + 3)$$

Calculate step-by-step:

1. Multiply $(13 + m)$ by $\frac{1}{2}$:

$$\frac{13 + m}{2}$$

2. Add $(m + 3)$:

$$\frac{13 + m}{2} + m + 3$$

Express all terms with a common denominator:

$$\frac{13 + m}{2} + \frac{2m}{2} + \frac{6}{2}$$

Sum:

$$\frac{13 + m + 2m + 6}{2} = \frac{13 + 3m + 6}{2} = \frac{19 + 3m}{2}$$

Set equal to zero for divisibility:

$$\frac{19 + 3m}{2} = 0$$

Multiply both sides by 2:

$$19 + 3m = 0$$

Solve for m:

$$3m = -19$$

$$ m = -\frac{19}{3} $$

Conclusion:

The value of M that makes the polynomial exactly divisible by $2y - 1$ is:

$M = -\frac{19}{3}$

Additional Insights and Considerations

Why Does This Approach Work?

This problem hinges on the Remainder Theorem, which simplifies divisibility checks for polynomials. By evaluating the polynomial at the root of the divisor, one can determine whether the polynomial is divisible by that divisor. If the polynomial evaluates to zero at that point, then the divisor is a factor of the polynomial.

Verifying the Solution

To ensure the solution is correct, you can:

- Substitute $m = -\frac{19}{3}$ into the polynomial.
- Confirm that $P(y)$ evaluated at $y = \frac{1}{2}$ yields zero.

Additional Tips for Similar Problems

- Identify the divisor's root: For a divisor $a y + b$, compute $y = -b/a$.
- Express the polynomial in standard form: Combine like terms for clarity.
- Use the Remainder Theorem: To find divisibility conditions without polynomial division.
- Solve for the parameter: Isolate the variable (like M) to find its value.

Summary

In this detailed analysis, we've demonstrated how to find the value of M in the expression $2y + my + 11y + m + 3$, simplified to $(13 + m) y + (m + 3)$, such that it's exactly divisible by $2y - 1$. Using the Remainder Theorem, the key step was evaluating the polynomial at $y = \frac{1}{2}$, leading us to the solution:

$M = -\frac{19}{3}$

This problem illustrates the power of polynomial evaluation techniques and fundamental algebraic principles to solve divisibility questions efficiently. Remember, recognizing the structure of the divisor and applying the Remainder Theorem can save significant time and effort in algebraic problem-solving.

Happy solving!

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