Dividing polynomials using synthetic division worksheet answer key pdf

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Dividing polynomials is an arithmetic operation where we divide a polynomial by another polynomial, generally with a lesser degree as compared to the dividend. The division of two polynomials may or may not result in a polynomial. Let's learn about dividing polynomials in this article in detail. What is Dividing Polynomials? Polynomials are algebraic expressions that consist of variables and coefficients. It is written in the following format: 5x2 + 6x - 17. This polynomial has three terms that are arranged according to their degree. The term with the highest degree is placed first, followed by the lower ones. Dividing polynomials is an algorithm to solve a rational number that represents a polynomial divided by a monomial or another polynomial. The divisor and the dividend are placed exactly the same way as we do for regular division. For example, if we need to divide 5x2 + 7x + 25 by 6x - 25, we write it in this way: \[\dfrac{(5 x ^2+7 x+25)}{(6 x -25)}\] The polynomial written on top of the bar is the numerator (5x2 + 7x + 25), while the polynomial written below the bar is the denominator (6x - 25). This can be understood by the following figure which shows that the numerator becomes the dividend and the denominator becomes the divisor. Dividing Polynomials by Monomials While dividing polynomials by monomials, the division can be done in two ways. One is by simply separating the '+' and '-' operator signs. That means, we break the polynomial from the operating sign, and solve each part separately. Another method is to do the simple factorization and further simplifying. Let us have a look at both methods in detail. Splitting the Terms Method Split the terms of the polynomial separated by the operator ('+' or '-') between them and simplify each term. For example, (4x2 - 6x) ÷ (2x) can be solved as shown here. We first take common terms from the numerators and denominators of both the terms, we get, [(4x2) / (2x)] - [(6x) / (2x)]. Canceling the common term 2x from the numerator and the denominator, we get 2x - 3. Factorization Method When you divide polynomials you may have to factor the polynomial to find a common factor between the numerator and the denominator. For example: Divide the following polynomial: (2x2 + 4x) ÷ 2x. Both the numerator and denominator have a common factor of 2x. Thus, the expression can be written as 2x(x + 2) / 2x. Canceling out the common term 2x, we get x+2 as the answer. Dividing Polynomials by Binomials For dividing polynomials by binomials or any other type of polynomials, the most common and general method is the long division method. When there are no common factors between the numerator and the denominator, or if you can't find the factors, you can use the long division process to simplify the expression. Dividing Polynomials Using Long Division Let us go through the algorithm of dividing polynomials by binomials using an example: Divide: (4x2 - 5x - 21) ÷ (x - 3). Here, (4x2 - 5x - 21) is the dividend, and (x - 3) is the divisor which is a binomial. Observe the division shown below, followed by the steps. Step 1. Divide the first term of the dividend (4x2) by the first term of the divisor (x), and put that as the first term in the quotient (4x). Step 2. Multiply the divisor by that answer, place the product (4x2 - 12x) below the dividend. Step 3. Subtract to create a new polynomial (7x - 21). Step 4. Repeat the same process with the new polynomial obtained after subtraction. So, when we are dividing a polynomial (4x2 - 5x - 21) with a binomial (x - 3), the quotient is 4x+7 and the remainder is 0. Dividing Polynomials Using Synthetic Division Synthetic division is a technique to divide a polynomial with a linear binomial by only considering the values of the coefficients. In this method, we first write the polynomials in the standard form from the highest degree term to the lowest degree terms. While writing in descending powers, use 0's as the coefficients of the missing terms. For example, x3+3 has to be written as x3 + 0x2 + 0x + 3. Follow the steps given below for dividing polynomials using the synthetic division method: Let us divide x2 + 3 by x - 4. Step 1: Write the divisor in the form of x - k and write k on the left side of the division. Here, the divisor is x-4, so the value of k is 4. Step 2: Set up the division by writing the coefficients of the dividend on the right and k on the left. [Note: Use 0's for the missing terms in the dividend] Step 3: Now, bring down the coefficient of the highest degree term of the dividend as it is. Here, the leading coefficient is 1 (coefficient of x2). Step 4: Multiply k with that leading coefficient and write the product below the second coefficient from the left side of the dividend. So, we get, 4×1=4 that we will write below 0. Step 5: Add the numbers written in the second column. Here, by adding we get 0+4=4. Step 6: Repeat the same process of multiplication of k with the number obtained in step 5 and write the product in the next column to the right. Step 7: At last, we will write the final answer which will be one degree less than the dividend. So, here, in our dividend, the highest degree term is x2, therefore, in the quotient, the highest degree term will be x. Therefore, the answer obtained is x+4+(19/x-4). Topics Related to Dividing Polynomials Check these articles to know more about the concept of dividing polynomials and its related topics. Example 1: Alex is stuck on a problem while working on dividing polynomials. Can you help him to obtain the quotient: (x4 - 10x3 + 27x2 - 46x + 28) ÷ (x - 7). Solution: Therefore, the quotient is x3 - 3x2 + 6x - 4. Example 2: Stacy needs help in finding the remainder while dividing polynomials. Can you help her solve this? (4x3 + 5x2 + 5x + 8) ÷ (4x + 1) Solution: Using the long division method of dividing polynomials, we get, Therefore, the remainder is 7. Show More > go to slidego to slide Have questions on basic mathematical concepts? Become a problem-solving champ using logic, not rules. Learn the why behind math with our certified experts Book a Free Trial Class FAQs on Dividing Polynomials Dividing polynomials is one of the arithmetic operations performed on two given polynomials. In this, the dividend is generally of a higher degree and the divisor is a lower degree polynomial. Why is Dividing Polynomials Important? Dividing polynomials is important because it provides an algorithm to solve a rational number that represents a polynomial divided by a monomial or another polynomial. What is the Easiest Way for Dividing Polynomials? The easiest way to divide polynomials is by using the long division method. However, in the case of the division of polynomials by a monomial, it can be directly solved by splitting the terms or by factorization. What are the Two Methods of Dividing Polynomials? The two methods to divide polynomials are given below: Synthetic division method Long division method What is Polynomial Division Used for in Real-Life? We use polynomial division for various aspects of our day-to-day lives. We need it for coding, engineering, designing, architecting, and various other real-life areas. What Method of Dividing Polynomials by a Monomial is Best? In the case of the division of polynomials by a monomial, it can be directly solved by splitting the terms or by factorization. We can divide each term of the dividend with the given monomial and find the result. Live worksheets > English Finish!! Please allow access to the microphone Look at the top of your web browser. If you see a message asking for permission to access the microphone, please allow. Close In algebra, the synthetic division is one of the methods used to manually perform the Euclidean division of polynomials. The division of polynomials can also be done using the long division method. But, in comparison to the long division method of polynomials, the synthetic division requires lesser writing and fewer calculations. That means the synthetic division is the shorter method of the traditional long-division of a polynomial for the special cases when dividing by a linear factor. Let us understand the method to perform the synthetic division of polynomials in detail using solved examples. What is Synthetic Division? Synthetic division is a method used to perform the division operation on polynomials when the divisor is a linear factor. One of the advantages of using this method over the traditional long method is that the synthetic division allows one to calculate without writing variables while performing the polynomial division, which also makes it an easier method in comparison to the long division. We can represent the division of two polynomials in the form: p(x)/q(x) = Q(x) + R/(q(x)) where, p(x) is the dividend q(x) is the linear divisor Q(x) is quotient R is remainder Synthetic Division of Polynomials Definition When we divide a polynomial p(x) by a linear factor (x - a) (which is a polynomial of degree 1), Q(x) is the quotient polynomial and R is the remainder. p(x)/q(x) = p(x)/(x- a) = Quotient + (Remainder/(x - a)) p(x)/(x - a) = Q(x) + (R/(x - a)) The coefficients of p(x) are taken and divided by the zero of the linear factor. We use synthetic division in the context of the evaluation of the polynomials by the remainder theorem, wherein we evaluate the value of p(x) at "a" while dividing (p(x)/(x - a)). That is, to find if "a" is the factor of the polynomial p(x), use the synthetic division to find the remainder quickly. Let us understand this better using the example given below. Synthetic Division Example Richard sells apples. The previous day, his profits were x, and today, his profits are ((x × x) - 2). If the number of apples he sold was (x + 2), what was the profit made per apple? We obtain the solution by modelling the equation as (x2 + x - 2) ÷ (x + 2). Step 1: Write the coefficients of the dividend inside the box and zero of x + 2 as the divisor. Step 2: Bring down the leading coefficient 1 to the bottom row. Step 3: Multiply -2 by 1 and write the product -2 in the middle row. Step 4: Add 1 and -2 in the second column and write the sum -1 in the bottom row. Step 5: Now, multiply -2 by -1 (obtained in step 4) and write product 2 below -2. Step 6: Add -2 and 2 in the third column and write the sum 0 in the bottom row. Step 7: The bottom row gives the coefficient of the quotient. The degree of the quotient is one less than that of the dividend. So, the final answer is x - 1 + 0/(x + 2) = x - 1. Please note that the last box in the bottom row gives the remainder. The profit per apple is given by (x - 1). Synthetic Division vs Long Division Let us see how long division differs from the synthetic division of polynomials by comparing both methods. In the example given below, we will perform the division of the polynomial 4x2 - 5x - 21 by a linear polynomial x - 3. In the example given below, another polynomial 2x2 + 3x - 1 is divided by a linear polynomial x + 1. When a polynomial P(x) is to be divided by a linear factor, we write the coefficients alone, bring down the first coefficient, multiply, and add. Repeat the multiplication and addition until we reach the end term of the polynomial. Using synthetic division, we can perform complex division and obtain the solutions easily. Synthetic Division Method The following are the steps while performing synthetic division and finding the quotient and the remainder. We will take the following expression as a reference to understand it better: (2x3 - 3x2 + 4x + 5)/(x + 2) Check whether the polynomial is in the standard form. Write the coefficients in the dividend's place and write the zero of the linear factor in the divisor's place. Bring the first coefficient down. Multiply it with the divisor and write it below the next coefficient. Add them and write the value below. Repeat the previous 2 steps until you reach the last term. Separate the last term thus obtained which is the remainder. Now group the coefficients with the variables to get the quotient. Therefore, the result obtained after synthetic division of (2x3 - 3x2 + 4x + 5)/(x + 2) is 2x2 - 7x + 18 and remainder is -31 How to do Synthetic Division? Synthetic division of polynomials uses numbers for calculation and avoids the usage of variables. In the place of division, we multiply, and in the place of subtraction, we add. Write the coefficients of the dividend and use the zero of the linear factor in the divisor's place. Bring the first coefficient down and multiply it with the divisor. Write the product below the 2nd coefficient and add the column. Repeat until the last coefficient. The last number is taken as the remainder. Take the coefficients and write the quotient. Note that the resultant polynomial is of one order less than the dividend polynomial. Example: 1) Consider this division: (x3 - 2x3 - 8x - 35)/(x - 5). The polynomial is of order 3. The divisor is a linear factor. Let's use synthetic division to find the quotient. Thus, the quotient is one order less than the given polynomial. It is x2 + 3x + 7 and the remainder is 0. (x3 - 2x3 - 8x - 35)/(x - 5) = x2 + 3x + 7. Tips and Tricks on Synthetic Division: Write down the coefficients and divide them using the zero of the linear factor to obtain the quotient and the remainder. (P(x)/(x - a) = Q(x) + (R/(x - a)) When we do synthetic division by (bx + a), we should get (Q(x)/b) as the quotient. Perform synthetic division only when the divisor is a linear factor. Perform multiplication and addition in the place of division and subtraction that is used in the long division method. ☛Related Articles: Example 1: The distance covered by Steve in his car is given by the expression 9a2 - 39a - 30. The time taken by him to cover this distance is given by the expression (a - 5). Find the speed of the car. Solution: Speed is given as the ratio of the distance to the time. Speed = (9a2 - 39a - 30)/(a - 5) Speed = (9a + 6) Answer: Speed is given by the expression 9a + 6. Example 2: The volume of Sara's storage box is 8x3 + 12x2 - 2x - 3. She knows that the area of the box is 4x2 - 1. What could be the height of the box? Solution: Area (A) = length(l) × breadth(b) Given A = 4x2 - 1. This is of the form a2 - b2 = (a + b)(a - b) This can be expressed as, A = (2x + 1)(2x - 1) V = l × b × h = A × h h = (V/A) = (8x3 + 12x2 - 2x - 3)/[(2x + 1)(2x - 1)] Let's solve this by the synthetic division twice. Answer: Height of the box = 2x + 3. Example 3: Perform synthetic division to solve the following expression: (6x2 + 7x - 20)/(2x + 5). Solution: Let us have a look at the steps shown below, Answer: Quotient for the given division of polynomials = 3x - 4. View Answer > go to slidego to slidego to slide Great learning in high school using simple cues Indulging in rote learning, you are likely to forget concepts. With Cuemath, you will learn visually and be surprised by the outcomes. Book a Free Trial Class FAQs on Synthetic Division When a polynomial has to be divided by a linear factor, the synthetic division is the shortest method. It is an alternative to the traditional long division method used to solve the polynomial division. How do you Divide Polynomials by Synthetic Division? We can perform synthetic division using some general steps. Take the coefficients alone, bring the first down, multiply with the zero of the linear factor, and add with the next coefficient and repeat until the end. What is the Importance of the Synthetic Division? Synthetic division can be generalized and expanded to the division of any polynomial with any polynomial. It is an easier method in comparison to the long division method for performing division on polynomials with the linear divisor. What are the Advantages of the Synthetic Division of Polynomials? This method uses fewer calculations and is quicker than long division. It takes comparatively lesser space while computing the steps involved in the polynomial division. What are the Disadvantages of Synthetic Division? The synthetic division can be used only when the divisor is a linear polynomial. We have to follow the long division method for the other cases. What are the Main Uses of Synthetic Division of Polynomials? Synthetic division of polynomials helps in finding the zeros of the polynomial. It also reduces the complexity of the expression while dividing the polynomials by a linear factor. What is the Quotient in Synthetic Division? In synthetic division, the polynomial obtained is one power lesser than the power of the dividend polynomial. The result obtained can be arranged to form the quotient of the polynomial division.

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