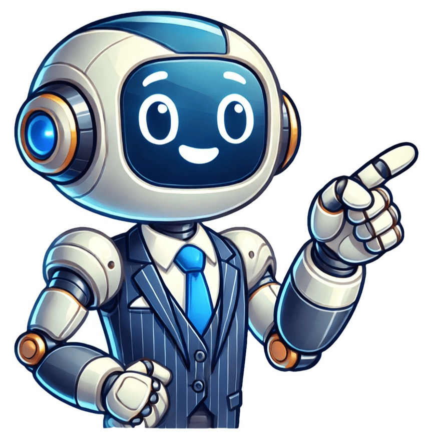

Producto de un monomio

Multiplying monomials follow almost the same method as the multiplication of integers. To multiply monomials with polynomials(binomials or trinomials), we use the distributive property whereby the monomial is multiplied by each term in the other polynomial. The resulting polynomial is simplified further by adding or subtracting the identical terms. What is Multiplying Monomial? Multiplying monomial is a method for multiplying a monomial with other polynomials. A monomials is referred to as a type of polynomials with just one term, consisting of a variable and its coefficient. The monomial is multiplied with the individual terms of the polynomial and then simplified further to get the resultant polynomial. To multiply polynomials, the coefficient is multiplied with a coefficient, and the variable is multiplied with a variable. Multiplying Monomial by a Monomial When a monomial is multiplied by another monomial, their product will be a monomial only. A monomial is an expression that has only one term in it. The coefficients of the monomials are multiplied together and then the variables are multiplied. For example, the product of two monomials, say 2x and 2y is equal to 4xy. In case, both the monomials have the same variables with the same exponents, then the laws of exponents are used. Example: Multiply 2x3 with 3x2 Step 1: First we will multiply the coefficients i.e., 2 × 3 = 6 Step 2: Next, we will multiply the variables but in this case, the powers of both the variables will be added as per the rules of exponents i.e., x3 × x2 = x5 The final answer is 2x3 × 3x2 = 6x5 Multiplication of Three or More Monomials To find the product of more than two monomials, then multiply the first two monomials, then multiply the product of these two by the third monomial. The same procedure is repeated for multiplying any number of monomials. Multiplying Monomial by a Binomial Binomials are also kind of polynomials consisting of only two terms. A binomial is defined as an algebraic expression consisting of two terms that are separated by the arithmetic signs, either the addition sign (+) or subtraction sign (-). When multiplying a monomial by a binomial, we follow the distributive law of multiplication. Let's take an example. Example: Multiply (3x) (2x – 9) Solution: Steps to solve (3x) (2x – 9): Step 1: Multiply the monomial with the first term of the binomial. = (3x) * (2x) = 6x 2 Step 2: Multiply the monomial with the second term of the binomial. = (3x) *(-9) = -27x Step 3: Write both the terms obtained in step 1 and step 2 together with their corresponding signs. = 6x 2 - 27x Multiplying Monomial by a Trinomial Trinomials are a particular kind of polynomials consisting of three terms. A trinomial is defined as an algebraic expression consisting of three terms separated by arithmetic symbols/signs, either the addition sign (+) or subtraction sign (-). When multiplying a monomial by a trinomial, we follow the distributive law of multiplication. Let's take an example. Example: Multiply (2x2) (3x+9y-6) Solution: Steps to solve (2x2) (3x+9y-6): Step 1: Multiply the monomial with the first term of the trinomial. = (2x2) * (3x) = 6x3 Step 2: Multiply the monomial with the second term of the trinomial. = (2x2) *(9y) = 18x2y Step 3: Multiply the monomial with the third term of the trinomial. = (2x2) *(-6) = -12x2 Step 4: Write all the three terms together with their corresponding signs. = 6x3 + 18x2y -12x2 Related Articles Check out these interesting articles to learn more about multiplying monomial and its related topics. Example 1: Using the multiplying monomial rule, multiply 11x and 2x. Solution: Given: Monomials, 11x and 2x. Step 1: In the above monomials, the common variable is x. We will multiply the variable with the variable. Hence, we get x × x = x2. Step 2: Multiply the coefficients of both the monomials to get 11 × 2 = 22. Thus, multiplying the polynomials 11x and 2x gives 22x2 as the result. Example 2: Multiply (2x)(4x2+7) Solution: Given: A monomial and a binomial, 2x and 4x2+7. Step 1: Multiply the monomial 2x with the first term of the given binomial, which is 4x2. Hence, we get 2x × 4x2 = 8x2. Step 2: Multiply the monomial 2x with the second term of the given binomial, which is 7. Hence, we get 2x × 7 = 14x. Thus, multiplying the polynomials 2x and 4x2+7 gives 8x2 + 14x as the result. View Answer > go to slidego to slide Breakdown tough concepts through simple visuals. Math will no longer be a tough subject, especially when you understand the concepts through visualizations. Book a Free Trial Class FAQs on Multiplying Monomial Multiplying Monomial is a method for multiplying a monomial with a polynomial. For multiplying monomials with polynomials(binomials or trinomials), we use the distributive property. Step 1: The monomial is multiplied by each of the terms in the other polynomial. Step 2: The resulting polynomial is then simplified. What Is the Method for Multiplying a Monomial by a Monomial? When multiplying monomials, follow the steps as given below: Step 1: Multiply the coefficients Step 2: Multiply the variables by adding the exponents. Step 3: Write the product so obtained Note: When multiplying monomials with the same base, the base will remain the same, just add their exponents. What Is the Product Rule for Multiplying Monomials? As per the rule, multiply the coefficients first and then multiply the variables by adding the exponents. When monomials with the same base are multiplied, their exponents get added. How To Solve Multiplying Monomials? For multiplying a monomial with a polynomial, we usually follow distributive law. When multiplying two monomials, we rewrite the product as a single monomial using properties of multiplication and exponents. When multiplying a monomial with a binomial, we follow the distributive law of multiplication and we get a binomial as the product. When multiplying a monomial with a trinomial, we follow the distributive law of multiplication and we get a trinomial as the product. What Are the Steps for Multiplying a Monomial by a Binomial? When multiplying monomial by binomial, we follow the distributive law of multiplication. Multiply the monomial with the first term of binomial. Multiply the monomial with the second term of binomial. Write both the terms together with their corresponding signs. Give the Steps for Multiplying a Monomial by a Trinomial? When multiplying monomial by trinomial, we follow the distributive law of multiplication. Multiply the monomial with the first term of trinomial. Multiply the monomial with the second term of trinomial. Multiply the monomial with the third term of trinomial. Write all the three terms together with their corresponding signs. Para multiplicar (o dividir) un monomio por un número, basta con multiplicar (o dividir) el coeficiente y conservar la parte literal Ejemplos: – – – Producto de monomios Para multiplicar monomios aplicamos la propiedad del producto de potencias de la misma base (se deja la base y se suman los exponentes). Ejemplos: – – Enviar un comentario Share — copy and redistribute the material in any medium or format for any purpose, even commercially. Adapt — remix, transform, and build upon the material for any purpose, even commercially. The licensor cannot revoke these freedoms as long as you follow the license terms. Attribution — You must give appropriate credit , provide a link to the license, and indicate if changes were made . You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. ShareAlike — If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original. No additional restrictions — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits. You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation . No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. La suma y resta de monomios también se llaman adición y sustracción de monomios respectivamente.Para que puedas entender del todo cómo sumar y restar dos o más monomios, a continuación te dejamos con varios ejemplos:Los monomios del último ejemplo no se pueden sumar ni restar porque los monomios no son semejantes, o dicho de otra forma, tienen diferentes incógnitas o exponentes.Para resolver el producto de un monomio por un número simplemente se debe multiplicar el coeficiente del monomio por dicho número, quedando la parte literal del monomio igual.El resultado de la multiplicación de dos monomios es otro monomio cuyo coeficiente es el producto de los coeficientes de los monomios y cuya parte literal se obtiene de multiplicar las variables que tienen la misma base, es decir, sumando sus exponentes.Por lo tanto, para multiplicar dos monomios diferentes se deben multiplicar los coeficientes entre sí y sumar los exponentes de las potencias que tengan la misma base.Sin embargo, si multiplicamos dos monomios con alguna potencia de base distinta, simplemente tenemos que multiplicar sus coeficientes entre sí y dejar las potencias igual. Por ejemplo:Por otro lado, en la multiplicación de monomios hay que tener en cuenta la regla de los signos:Un monomio positivo multiplicado por un monomio positivo da como resultado otro monomio positivo.Un monomio positivo por un monomio negativo (o viceversa) es igual a un monomio negativo.Dos monomios negativos multiplicados entre sí dan lugar a un monomio positivo.A continuación tienes con varios ejemplos de la multiplicación entre monomios para que puedas ver cómo se hace:Como has visto, resolver una multiplicación de monomios es relativamente fácil. Pero debes tener en cuenta que los monomios también se pueden multiplicar por polinomios, e incluso 2 o más polinomios se pueden multiplicar entre sí. Si estás más interesado, puedes ver cómo se hacen todas estas operaciones haciendo click en multiplicación de polinomios.En matemáticas, el resultado de la división de monomios es otro monomio cuyo coeficiente equivale al cociente de los coeficientes de los monomios y cuya parte literal se obtiene de dividir las variables que tienen la misma base, es decir, restando sus exponentes.Evidentemente, cualquier división de monomios también se puede expresar en forma de fracción:Al igual que en la multiplicación, en la división de monomios hay que aplicar la ley de los signos:Un monomio positivo dividido por un monomio positivo da como resultado otro monomio positivo.Un monomio positivo entre un monomio negativo (o viceversa) es igual a un monomio negativo.Dos monomios negativos divididos entre sí dan lugar a un monomio positivo.Puedes ver más ejemplos de cómo se dividen dos o más monomios a continuación:Seguro que alguna vez te has preguntado algo nuevo en matemáticas te has preguntado: ¿y para qué demonios sirve esto? Pues la división de monomios se utiliza para dividir polinomios, de hecho, es bastante frecuente equivocarse dividiendo polinomios porque se han dividido mal dos monomios. Por eso te recomendamos que, ahora que tienes fresca la división entre monomios, veas cómo se calcula la división de polinomios, ya que ahora te será mucho más fácil aprender el procedimiento (es bastante complicado).En matemáticas, para calcular la potencia de un monomio se eleva cada elemento del monomio al exponente de la potencia. Es decir, la potencia de un monomio consiste en elevar su coeficiente y sus variables (letras) al exponente de la potencia.Recuerda de las propiedades de las potencias que cuando elevamos un término que ya está elevado los dos exponentes se multiplican entre sí. Por eso en la potencia de un monomio siempre se multiplica el exponente de cada letra por el exponente que indica la potencia.Por otra parte, para hacer bien esta operación debes recordar la siguiente propiedad de las potencias:Un monomio negativo elevado a un exponente par es equivalente a un monomio positivo. En cambio, un monomio negativo elevado a un exponente impar da como resultado un monomio negativo.Te dejamos con varios ejemplos para que puedas comprender del todo cómo se calcula la potencia de un monomio:Una vez ya has visto cuáles son todas las operaciones con monomios, debes saber que también se pueden combinar entre sí. Es decir, nos podemos encontrar ejercicios en los que nos pidan de resolver operaciones con monomios donde intervengan todos los tipos: sumas, restas, multiplicaciones, divisiones y potencias.Pero no te preocupes, no son tan difíciles como aparentan. Lo único que debes recordar es el orden con el que se resuelven las operaciones combinadas:Primero se resuelven las operaciones con monomios de dentro de los paréntesis.Luego se calculan las potencias de monomios.En tercer lugar se hacen las multiplicaciones y las divisiones de monomios.Y, finalmente, se determinan las sumas y las restas de monomios.Seguro que resolviendo un ejemplo lo ves más claro:Primero de todo, debemos resolver las operaciones con monomios de los paréntesis:En este caso no tenemos ninguna potencia. Así que ahora calculamos las multiplicaciones y las divisiones de monomios:Y, por último, hacemos las sumas y las restas de monomios:Por si quieres practicar, a continuación te dejamos varios ejercicios resueltos paso a paso de dificultad de la ESO sobre operaciones con monomios.Calcula las siguientes sumas y restas de monomios:Resuelve las siguientes multiplicaciones de monomios: Determina el resultado de las siguientes divisiones de monomios:En la operación anterior hemos simplificado el término porque cualquier número elevado a 0 es igual a 1. Por lo tanto: Halla las siguientes potencias de monomios:Resuelve las siguientes operaciones combinadas con monomios y simplifica al máximo:No se puede simplificar más la operación porque los dos monomios tienen exponentes diferentes, por lo que el resultado es un polinomio.Si has llegado hasta aquí significa que ya dominas todas las operaciones con monomios. ¡Genial! Pues otra operación que seguramente te interese es el factorial de un número. Se trata de una operación bastante curiosa, ya que se calcula de manera diferente a cualquier otra. Y, de hecho, mucha gente no sabe qué es el factorial de un número. Descubre cómo se resuelve un factorial haciendo click en este enlace. ¿Alguna vez te has preguntado por qué los matemáticos parecen estar obsesionados con letras y números mezclados? ¿Para qué sirven expresiones como "$3x^2$" o "$−5ab^3$"? Si alguna vez te lo planteaste, estás a punto de descubrir no solo qué es un monomio, sino por qué son una piedra angular en el lenguaje del álgebra.En este artículo, recorreremos juntos, paso a paso, todo lo que necesitas saber sobre los monomios. Desde su definición más sencilla hasta operaciones más avanzadas, pasando por ejemplos claros, ejercicios resueltos y aplicaciones en el mundo real. Así que si te interesa entender el álgebra con profundidad pero sin complicaciones innecesarias, este artículo está hecho para ti.¿Qué es un monomio?Definición simple y formalEn términos sencillos, un monomio es una expresión algebraica que contiene un solo término. Es decir, un número, una letra o una combinación de ambos multiplicados entre sí.Definición formal: Un monomio es un producto entre un número real (llamado coeficiente) y una o más variables elevadas a exponentes naturales (es decir, enteros positivos o cero).Ejemplo: $5x^2$, $−3ab^3$, x, -7, 4mnpPartes de un monomioTodo monomio tiene tres partes esenciales:Coeficiente: el número que multiplica a la parte literal. Ej: En $−6xy^2$, el coeficiente es −6.Parte literal: la o las letras (variables) que representan cantidades desconocidas. Ej: xy^2.Exponentes: indican cuántas veces se multiplica una variable por sí misma. Ej: y^2 significa y × y.Ejemplos visualesMonomioCoeficienteParte literalExponentes$7x^2$7x2$−4ab^3$−4$ab^3$$a^1$, $b^3$1212—x1 (implícito)x1Características de un monomioGrado del monomioEl grado de un monomio es la suma de los exponentes de todas sus variables.Ejemplo: En $3x^2y^3$, el grado es 2 + 3 = 5.Signo del coeficienteUn monomio puede tener coeficiente positivo o negativo. El signo afecta directamente el resultado de las operaciones.Variable única o varias variablesMonomios simples: $2x^3$ (una sola variable).Monomios compuestos: $−5xyz^2$ (varias variables).Coeficientes fraccionarios o negativosLos monomios también pueden tener coeficientes fraccionarios o negativos, como:Clasificación de los monomiosSegún el número de variablesMonomio univariable: Tiene una sola letra. Ej: $7x^3$.Multivariable: Tiene dos o más letras. Ej: 2xy.Según el gradoMonomio de grado cero: Cuando no hay variables. Ej: 5.Grado uno: 3xGrado dos o superior: $4x^2$, $−2xy^3$Monomio nuloEl monomio nulo es aquel cuyo coeficiente es cero. Ej: $0x^3$. Independientemente de la parte literal, el resultado es siempre cero.Diferencias entre monomio, binomio y polinomioTérminoDefiniciónEjemploMonomioUn solo término$3x^2$BinomioDos términos separados por + o −x + 5, 3a − bPolinomioDos o más términos$2x^2 − x + 1$Importante: Un polinomio puede estar compuesto por monomios, binomios y más.Operaciones con monomiosSuma y resta de monomiosSolo se pueden sumar o restar monomios semejantes (mismas variables y mismos exponentes).Ejemplo: $3x^2 + 5x^2 = 8x^2$ 4ab − 2ab = 2abNo se pueden sumar: $3x^2 + 5x^3$Multiplicación de monomiosSe multiplican los coeficientes entre sí y las variables sumando los exponentes.Ejemplo: $(2x^3)(3x^2) = 6x^5$ $(−4a^2b)(5ab^3) = −20a^3b^4$División de monomiosSe dividen los coeficientes y se restan los exponentes de las mismas variables.Ejemplo: $(6x^5) ÷ (2x^2) = 3x^3$ $(−8a^3b^3) ÷ (2ab) = −4a^2b^2$Potencia de un monomioElevar un monomio a una potencia significa elevar el coeficiente y cada variable a ese exponente.Ejemplo: $(2x^3)^2 = 4x^6$ $(−3ab^2)^3 = −27a^3b^6$Monomios semejantes¿Cómo identificarlos?Deben tener la misma parte literal y los mismos exponentes. El orden no importa.Ejemplo: $2xy^2$ y $−5xy^2$ son semejantes. $3x^2y$ y $3xy^2$ no lo son.¿Cómo simplificarlos?Se suman o restan los coeficientes, y se conserva la parte literal.$7a^2 − 2a^2 + a^2 = (7 − 2 + 1)a^2 = 6a^2$Aplicaciones de los monomiosÁlgebra: Resolución de ecuaciones y simplificación de expresiones.Geometría: Área del cuadrado ($A = l^2$) es un monomio.Física:Energía cinética: $E = ½mv^2$Velocidad: v = d/t (si $d = 5t^2$, entonces v = 5t)Los monomios aparecen en cualquier campo donde haya fórmulas y variables.Errores comunes al trabajar con monomiosConfundir monomios semejantes con los que no lo son.Olvidar sumar o restar solo los coeficientes.No aplicar correctamente las reglas de los exponentes al multiplicar o dividir.Error con signos negativos: $−x × −x = x^2$, no $−x^2$.Ejercicios resueltosSuma: $3x^2 + 4x^2 = 7x^2$Multiplicación: $−2a^2b × 3ab^2 = −6a^3b^3$División: $8x^5 ÷ 2x^2 = 4x^3$Potencia: $(x^2y)^3 = x^6y^3$Simplificación: $5xy^2 − 3xy^2 + xy^2 = 3xy^2$Actividades interactivas recomendadasGlosario de términos relacionadosPolinomio: Expresión algebraica con uno o más términos.Término algebraico: Cualquier combinación de número y variables.Coeficiente: Número que multiplica a las variables.Exponente: Indica la potencia a la que está elevada una variable.Variable: Letra que representa una cantidad desconocida.Preguntas frecuentes sobre monomios (FAQs)¿Un número solo puede ser un monomio? Sí, todo número real sin variables también es un monomio (de grado cero).¿Cuál es la diferencia entre monomio y término algebraico? Todo monomio es un término algebraico, pero no todo término algebraico forma un monomio si está en una suma o resta con otros.¿Se puede dividir un monomio entre otro? Sí, siempre que se respeten las reglas de los exponentes y no se divida por cero.Recursos adicionales y bibliografíaLibros recomendados:Baldor, Álgebra, capítulos 3 y 4.Stewart, Precalculus: Mathematics for Calculus.Videos:YouTube: Monomios – Academia InternetMath2me – Monomios paso a pasoEjercicios descargables:PDF con ejercicios de monomios – Liveworksheets¿Listo para dominar el mundo de los monomios? Ya tienes las herramientas. Solo falta una cosa: ¡practicar! Como todo en matemáticas, el verdadero dominio viene con la repetición consciente y la curiosidad por entender, no solo memorizar.Ejercicios interactivos sobre monomios Prior Skills Algebraic expressions Power with a natural exponent A monomial is the product of numbers, variables, and powers. For example, the expressions 5a, 3ab2 and −62aa2b3 are monomials. Here are more examples of monomials: A monomial is also any single number, any variable, or any power. For example, number 9 is a monomial, variable x is a monomial, power 52 is a monomial. Converting a monomial to the standard form Consider the following monomial: This monomial does not look very neat. To make it simpler, we need to reduce it to the standard form. To reduce a monomial to the standard form is to multiply the same-type factors that make up the monomial. That is, numbers should be multiplied with numbers, variables with variables, powers with powers. As a result of these actions, we obtain a simplified monomial, which is identically equal to the previous one. Another nuance is that powers can only be multiplied in a single term if they have the same bases. So, let us reduce the monomial 3a25a3b2 to the standard form. This monomial contains numbers 3 and 5. Multiply them and we get number 15. Write it down: 15 Then the monomial 3a25a3b2 contains powers a2 and a3, which have the same base a. It is known from identical transformations with powers that when multiplying powers with the same base, the base is left unchanged, and the exponents are added. Then multiplication of powers a2 and a3 will result in a5. Write a5 next to number 15 15a5 Next, the monomial 3a25a3b2 contains the power of b2. There is nothing to multiply it with, so it remains unchanged. We write it as it is to the new monomial: 15a5b2 We reduced the monomial 3a25a3b2 to the standard form. As a result, we obtained the monomial 15a5b2 3a25a3b2 = 15a5b2 The numeric factor 15 is called the coefficient of the monomial. When converting a monomial to the standard form, the coefficient should be written first, and only then the variables and powers. If there is no coefficient in a monomial, then the coefficient is said to be equal to one. Thus, the coefficient of the monomial abc is 1, since abc is the product of one and abc 1 × abc And the coefficient of the monomial -abc is -1, because -abc is the product of minus one and abc −abc = −1 × abc The power of a monomial is the sum of the exponents of all the variables in the monomial. For example, the power of the monomial 15a5b2 is 7. This is because the variable a has exponent 5, and the variable b has exponent 2. Hence 5 + 2 = 7. The exponent of the numerator 15 need not be counted, because we are interested only in the exponents of the variables. Another example. The power of the monomial 7ab2 is 3. Here the variable a has exponent 1, and the variable b has exponent 2. Hence 1 + 2 = 3. If a monomial does not contain variables or powers, but consists of a number, then we say that the power of such a monomial is zero. For example, the power of a monomial 11 is zero. The power of a monomial should not be confused with the power of a number. The power of a number is the product of several identical factors, while the power of a monomial is the sum of the exponents of all variables in the monomial. There are no variables in the monomial 11, so its power is zero. Example 1. To reduce the monomial 5xx3ya2 to the standard form Multiply the numbers 5 and 3 to get 15. This will be the coefficient of the monomial: 15 Then the monomial 5xx3ya2 contains the variables x and x. Multiply them, and we get x2. 15x2 Next, the monomial 5xx3ya2 contains the variable y, which has nothing to multiply with. We write it down unchanged: 15x2y Then the monomial 5xx3ya2 contains the power of a2, which also has nothing to multiply. We also leave it unchanged: 15x2ya2 We obtained the monomial 15x2ya2, which is reduced to the standard form. Alphabetic factors are usually written in alphabetical order. Then the monomial 15x2ya2 takes the form 15a2x2y. Therefore, 5xx3ya2 = 15a2x2y. Example 2. To reduce the monomial 2m3n × 0.4mn to the standard form Multiply numbers, variables, and powers separately. 2m3n × 0.4mn = 2 × 0.4 × m3 × m × n × n = 0.8m4n2 Numbers, variables, and powers are allowed to be bracketed for multiplication. This is done for convenience. For example, in this example the multiplication of 2 and 0.4 can be put in brackets. Also the multiplication of m3 × m and n × n can be put in brackets. 2m3n × 0.4mn = (2 × 0.4) × (m3 × m) × (n × n) = 0.8m4n2 But it is desirable to perform all elementary actions in mind. Thus, the solution can be written down much shorter: 2m3n × 0.4mn = 0.8m4n2 But in order to be able to reduce a monomial to the standard form in your mind, the topic of multiplication of integers and multiplication of powers must be studied at a good level. Adding and subtracting monomials Monomials can be added and subtracted. For this to be possible, they must have the same letter part. The coefficients can be any. The addition and subtraction of monomials is essentially the reduction of like terms, which we discussed in our study of letter expressions. To add (subtract) monomials, add (subtract) their coefficients, and leave the letter part unchanged. Example 1. Add the monomials 6a2b and 2a2b 6a2b + 2a2b Let's add the coefficients 6 and 2, and leave the letter part 6a2b unchanged 6a2b + 2a2b = 8a2b Example 2. Subtract from the monomial 5a2b3 the monomial 2a2b3 5a2b3 − 2a2b3 You can replace subtraction with addition, and add the coefficients of the monomials, leaving the letter part unchanged: 5a2b3 − 2a2b3 = 5a2b3 + (−2a2b3) = 3a2b3 Or subtract the coefficient of the second monomial from the coefficient of the first monomial, and leave the letter part unchanged: 5a2b3 − 2a2b3 = 3a2b3 Multiplication of monomials Monomials can be multiplied. To multiply monomials, you must multiply their numeric and alphabetic parts. Example 1. Multiply the monomials 5x and 8y Let us multiply the numeric and alphabetic parts separately. For convenience, the multipliers to be multiplied will be enclosed in brackets: 5x × 8y = (5 × 8) × (x × y) = 40xy Example 2. Multiply the monomials 5x2y3 and 7x3y2c Let us multiply the numeric and alphabetic parts separately. During multiplication we will apply the rule of multiplication of powers with equal bases. We will put the multiplied factors in brackets: 5x2y3 × 7x3y2c = (5 × 7) × (x2x3) × (y3y2) × c = 35x5y5c Example 3. Multiply the monomials −5a2bc and 2a2b4 −5a2bc × 2a2b4 = (−5 × 2) × (a2a2) × (bb4) × c = −10a4b5c Example 4. Multiply the monomials x2y5 and (−6xy2) x2y5 × (−6xy2) = −6 × (x2x) × (y5y2) = −6x3y7 Example 5. Find the value of the expression Division of monomials A monomial can be divided by another monomial. To do this, divide the coefficient of the first monomial by the coefficient of the second monomial, and divide the letter part of the first monomial by the letter part of the second monomial. The rule of division of powers is used. For example, divide the monomial 8a2b2 by the monomial 4ab. Write this division as a fraction: We will call the first monomial 8a2b2 a dividend, and the second 4ab a divisor. We will call the resulting monomial the coefficient. Divide the coefficient of the dividend by the coefficient of the divisor, we get 8 : 4 = 2. In the original expression we put an equal sign and write this coefficient of the coefficient: Now divide the letter part. The dividend contains a2, the divisor contains just a. Divide a2 by a, we get a, because a2 : a = a2 - 1 = a. We write in the coefficient a after 2 Next, the dividend contains b2, the divisor contains just b. We divide b2 by b, we get b, because b2 : b = b2 - 1 = b. We write in the coefficient b after a So, dividing the monomial 8a2b2 by the monomial 4ab results in the monomial 2ab. You can check right away. When you multiply the coefficient by the divisor, you should get the dividend. In our case, if 2ab is multiplied by 4ab, you should get 8a2b2 2ab × 4ab = (2 × 4) × (aa) × (bb) = 8a2b2 It is not always possible to divide the first one by the second one. For example, if the divisor has a variable that is not in the dividend, then division is impossible. For example, the monomial 6xy2 cannot be divided by the monomial 3xyz. The divisor 3xyz contains a variable z that is not contained in the dividend 6xy2. Simply put, we cannot find a coefficient which, when multiplied by the divisor 3xyz, would result in a dividend of 6xy2, because that multiplication would necessarily contain a variable z that does not exist in 6xy2. But if the dividend contains a variable that is not in the divisor, then division will be possible. In this case, the variable that was not in the divisor will be transferred to the coefficient unchanged. For example, dividing a monomial 4x2y2z by 2xy yields 2xyz. First divide 4 by 2 to get 2, then x2 divided by x to get x, then y2 divided by y to get y. Then we proceeded to divide variable z by the same variable in the divisor, but found that there was no such variable in the divisor. So we transferred the variable z to the coefficient without changing it: To check, multiply the coefficient 2xyz by the divisor 2xy. The result should be the monomial 4x2y2z 2xyz × 2xy = (2 × 2) × (xx) × (yy) × z = 4x2y2z But in some fractions, if division is not possible, it is possible to perform reduction. This is done to simplify the expression. Thus, in the previous example, it was impossible to divide the monomial 6xy2 by the monomial 3xyz. But it is possible to reduce this fraction by a monomial 3xy. Recall that fraction reduction is the division of the numerator and denominator by the same number (in our case, by the monominant 3xy). As a result, the fraction becomes simpler, but its value does not change: In the numerator and denominator we come to the division of the monomials, which can be done: The division process is usually done in your head by writing the result above the numerator and denominator: Example 2. Divide the monomial 12a2b3c3 by the monomial 4a2bc Example 3. Divide the monomial x2y3z by the monomial xy2 Additionally, let us mention that dividing a monomial by a monomial is also impossible if one of the powers included in the dividend has an index smaller than the index of the same power from the divisor. For example, we cannot divide a monomial 2x by a monomial x2 because the power of x that is part of the divisor has an index of 1, while the power of x2 that is part of the divisor has an index of 2. We cannot find a coefficient that, when multiplied with the divisor x2, would result in the dividend 2x. Of course, we can divide x by x2, using the property of the power with an integer: and such a coefficient multiplied with the divisor x2 will result in a dividend of 2x But so far we are interested only in those coefficients which are so-called integer expressions. Integer expressions are those expressions that are not fractions, the denominator of which contains a letter expression. And a coefficient is not an integer expression. It is a fractional expression with a letter expression in the denominator. Expanding a monomial to a power A monomial can be raised to a power. To do this, use the Power of a Power Rule (Exponents). Example 1. Raise the monomial xy to the second power. To raise the monominant xy to the second power, you must raise to the second power each factor of this monominant (xy)2 = x2y2 Example 2. Raise the monomial −5a3b to the second power. (−5a3b)2 = (−5)2 × (a3)2 × b2 = 25a6b2 Example 3. Raise the monomial −a2bc3 to the fifth power. In this example, the coefficient of the monomial is -1. This coefficient must also be raised to the fifth power: (−a2bc3)5 = (−1)5 × (a2)5 × b5 × (c3)5 = −1a10b5c15 = −a10b5c15 When the coefficient is equal to -1, the unit itself is not written down. Only the minus and then the other factors of the monomial are written down. In the above example we first obtain the monomial −1a10b5c15, then it was replaced by the identically equal monomial −a10b5c15. Example 4. Present the monomial 4x2 as a squared monomial. In this example, we need to find a product that is equal to 4x2 in the second power. Obviously, it is the product of 2x. If this product is raised to the second power (squared), then we get 4x2 (2x)2 = 22x2 = 4x2 So 4x2 = (2x)2. The expression (2x)2 is a squared monomial. Example 5. Represent the monomial 121a6 as a squared monomial. Let's try to find a product that is equal to the expression 121a6 in the second power. First of all, note that number 121 is obtained if number 11 is squared. That is, we found the first factor of the future product. The power of a6 is obtained by squaring the power of a3. Thus the second factor of the future product is a3. Thus, if the product of 11a3 is squared to the second power we obtain 121a6 (11a3)2 = 112 × (a3)2 = 121a6 So 121a6 = (11a3)2. The expression (11a3)2 is the squared monomial. Decomposition of a monomial into factors Since a monomial is the product of numbers, variables, and powers, it can be decomposed into the factors it consists of. Example 1. Decompose the monomial 3a3b2 into factors This monomial can be decomposed into the factors 3, a, a, a, b, b 3a3b2 = 3aaabb Either the power of b2 does not need to be decomposed into the factors b and b 3a3b2 = 3aaab2 Either the power of b2 can be decomposed into the factors b and b, and the power of a3 can be left unchanged. 3a3b2 = 3a3bb How to represent the monomial depends on the task to be solved. The main thing is that the decomposition must be identically equal to the original monomial. Example 2. Decompose the monomial 10a2b3c4 into factors. Decompose coefficient 10 into factors 2 and 5, decompose power a2 into factors aa, decompose power b3 into factors bbb, and decompose power c4 into factors cccc 10a2b3c4 = 2 × 5 × aabbbcccc Tasks for independent decision Task 1. Reduce the monomial -2aba to the standard form. Solution: Task 2. Reduce the monomial 0.5m × 2n to the standard form. Solution: 0.5m × 2n = (0.5 × 2)(mn) = 1mn = mn Task 3. Reduce the monomial −8ab(−2.5)b2 to the standard form. Solution: −8ab(−2.5)b2 = −8 × (−2.5) × a × (b × b2) = 20ab3 Task 4. Reduce the monomial 0.15pq × 4pq2 to the standard form. Solution: Task 5. Reduce the monomial −2x3 × 0.5xy2 to the standard form. Solution: Task 6. Reduce the monomial 2m3n × 0.4mn to the standard form. Solution: Task 7. Reduce the monomial to the standard form. Solution: Task 8. Reduce the monomial to the standard form. Solution: Task 9. Multiply the monomials 2x and 2y Task 10. Multiply the monomials 6x, 5x, and y Solution: 6x × 5x × y = 30x2y Task 11. Multiply the monomials 2x2, 2x3 and y2 Solution: 2x2 × 2x3 × y2 = (2 × 2) × (x2x3) × y2 = 4x5y2 Task 12. Multiply the monomials −8x and 5x3 Solution: −8x × 5x3 = (−8 × 5)×(xx3) = −40x4 Task 13. Multiply the monomials x2y5 and (−6xy2) Solution: x2y5 × (−6xy2) = −6 × (x2x) × (y5y2) = −6x3y7 Task 14. Perform multiplication: Solution: Task 15. Perform multiplication: Solution: Task 16. Raise the monomial x2y2z2 to the third power Solution: (x2y2z2)3 = (x2)3 × (y2)3 × (z2)3 = x6y6z6 Task 17. Raise the monomial xy2z3 to the fifth power. Solution: (xy2z3)5 = x5 × (y2)5 × (z3)5 = x5y10z15 Task 18. Raise the monomial 4x to the second power. Solution: (4x)2 = 42 × x2 = 16x2 Task 19. Raise the monomial 2y3 to the third power. Solution: (2y3)3 = 23 × (y3)3 = 8y9 Task 20. Raise the monomial -0.6x3y2 to the third power. Solution: (−0.6x3y2)3 = (−0.6)3 × (x3)3 × (y2)3= −0.216x9y6 Task 21. Raise the monomial -x2yz3 to the fifth power. Solution: (−x2yz3)5 = (−x2)5 × y5 × (z3)5= −x10y5z15 Task 22. Raise the monomial -x3y2z to the second power. Solution: (−x3y2z)2 = (−x3)2 × (y2)2 × z2 = x6y4z2 Task 23. Represent the monomial -27x6y9 as a monomial raised to a cube. Solution: −27x6y9 = (−3x2y3)3 Task 24. Represent the monomial −a3b6 as a monomial raised to a cube. Solution: −a3b6 = (−ab2)3 Task 25. Perform division Solution: Task 26. Perform division Solution: Task 27. Perform division Solution: Task 28. Perform division Solution: Task 29. Perform division Solution: Task 30. Perform division Solution: Page 2 Prior Skills Power with a natural exponent Perimeter, area and volume Monomials A polynomial is the sum of monomials. For example, the expression 2x + 4xy2 + x + 2xy2 is a polynomial. Simply put, a polynomial is several monomials connected by a plus sign. In some polynomials, monomials can be joined by a minus sign. For example, 3x - 5y - 2x. Keep in mind that this is still the sum of monomials. The polynomial 3x - 5y - 2x is the sum of monomials 3x, -5y and - 2x, that is 3x + (-5y) + (-2x). After opening brackets the polynomial 3x - 5y - 2x is formed. 3x + (−5y) + (−2x) = 3x − 5y − 2x Accordingly, when considering each monomial of a polynomial separately, it should be considered together with the sign that is placed in front of it. Thus, in the polynomial 3x - 5y - 2x, the minus before the monomial 5y refers to the quotient 5, and the minus before the monomial 2x refers to the quotient 2. To not contradict the definition of the polynomial, subtraction can be replaced with addition: 3x − 5y − 2x = 3x + (−5y) + (−2x) But this action overloads the polynomial with brackets, so subtraction is not replaced by addition, given that in the future each monomial of the polynomial will be considered together with the sign that is placed in front of it The monomials that make up a polynomial are called polynomial terms. If a polynomial consists of two terms, then such a polynomial is called a binomial. For example, the polynomial x + y is a binomial. If a polynomial has three terms, then such a polynomial is called a trinomial. For example, a polynomial x + y + z is a trinomial. If any polynomial contains a regular number, then that number is called a free term of the polynomial. For example, in the polynomial 3x + 5y + z + 7, the term 7 is a free term. The free term of a polynomial contains no letter part. A polynomial is also any numeric expression. Thus, the following expressions are polynomials: 2 + 3 5 + 3 + 2 5 − 4 + 9 Adding polynomials You can add another polynomial to a polynomial. For example, add a polynomial 2x + y to the polynomial 3x + y. Put each polynomial in brackets and connect them with a plus sign, thus indicating that we are adding polynomials: (2x + y) + (3x + y) Now open the brackets: 2x + y + 3x + y The following are like terms: 2x + y + 3x + y = 5x + 2y Thus, adding polynomials 2x + y and 3x + y results in a polynomial 5x + 2y. Adding polynomials in columns is also allowed. To do this, write them so that like terms are located under each other, then perform addition. Let's solve the previous example in columns: If one of the polynomials contains a term that does not have a like term in the other polynomial, it is transferred to the result without change. For example, add the polynomials 2x2 + y3 + z + 2 and 5x2 + 2y3. First, write them so that like terms are located under each other, and then add them together. We find that the second polynomial does not contain any terms which can be added to the terms z and 2 of the first polynomial. Therefore the terms z and 2 are transferred to the result unchanged (together with their signs) Let's solve the same example using brackets: (2x2 + y3 + z + 2) + (5x2 + 2y3) = 2x2 + y3 + z + 2 + 5x2 + 2y3 = (2x2 + 5x2) + (y3 + 2y3) + z + 2 = 7x2 + 3y3 + z + 2 Example 3. Add polynomials 7x3 + y + z2 and x3 − z2 Let's solve this example in a column. Write the second polynomial under the first one so that like terms are located under each other: The second polynomial had no term that could be added to the y term from the first polynomial, so this term was transferred to the result unchanged. And addition of like terms z2 and -z2 gave 0 as a result. By tradition, we do not write down zero. Therefore, the final answer is 8x3 + y. Let's solve the same example using brackets: (7x3 + y + z2) + (x3 − z2) = 7x3 + y + z2 + x3 − z2 = (7x3 + x3) + (z2 − z2) + y = 8x3 + y Subtracting polynomials You can subtract another polynomial from a polynomial. For example, subtract a polynomial 2x + y by a polynomial 3x + y. Put each polynomial in brackets and connect them with a "minus" sign, thus indicating that we are subtracting: (2x + y) − (3x + y) Now let's open the brackets: 2x + y − 3x − y Let us give like terms. The terms y and -y are opposite. The sum of the opposite terms is zero y + (−y) = 0 Given like terms, we usually add them up. But we can use the sign of a monomial as the sign of the operation. So, by adding like terms y and -y we add them by the rule of adding like terms. But we can write them one after another without adding them y − y The same result will be obtained since the expressions y + (-y) and y - y are equally equal to zero: y − y = 0 Let's go back to our example. We cross out the terms y and -y: And addition of like terms 2x and -3x, will result in -x 2x + (−3x) = −x Or without addition, by writing the terms one after the other: 2x − 3x = −x So, if you subtract a polynomial (2x + y) from a polynomial (3x + y), you get a monomial -x. Let's solve the same example in a column: Example 2. Subtract from a polynomial 13x - 11y + 10z a polynomial -15x + 10y - 15z Let's solve this example using brackets and then in columns: (13x − 11y + 10z) − (−15x + 10y − 15z) = 13x − 11y + 10z + 15x − 10y + 15z = (13x + 15x) + (−11y − 10y) + (10z + 15z) = 28x + (−21y) + 25z = 28x − 21y + 25z You must be careful when subtracting in columns. If you don't pay attention to the signs, you are very likely to make a mistake. It is necessary to consider not only the sign of the subtraction operation, but also the sign in front of the summand. So, in this example, the summand -15x was subtracted from the summand 13x. The result of calculating this expression must be positive, because 10z - (-15z) = 10z + 15z. When adding or subtracting polynomials with brackets, the first polynomial may not be put in brackets. For example, in this example we wanted to subtract -15x + 10y - 15z from a polynomial 13x - 11y + 10z The subtraction was written as follows: (13x − 11y + 10z) − (−15x + 10y − 15z) But you can leave the first polynomial out of the brackets: 13x − 11y + 10z − (−15x + 10y − 15z) Putting the first polynomial in brackets at first allows beginners to visually see that the second polynomial is completely subtracted from the first polynomial, not from a certain part of it. Representing a polynomial as a sum or a difference A polynomial can be represented as a sum or difference of polynomials. This is essentially the inverse of opening brackets, because the idea implies that there is a polynomial, and from it we can form a sum or difference of polynomials by putting some of the terms of the original polynomial into brackets. Let have a polynomial 3x + 5y + z + 7. Let us represent it as a sum of two polynomials. So, from the terms of the original polynomial we need to form two polynomials added to each other. Let's bracket the terms 3x and 5y, and the terms z and 7. Then combine them with a plus sign (3x + 5y) + (z + 7) The value of the original polynomial does not change. If we open brackets in the resulting expression (3x + 5y) + (z + 7), we get the polynomial 3x + 5y + z + 7 again. (3x + 5y) + (z + 7) = 3x + 5y + z + 7 You could also put the terms 3x, 5y, z in brackets and add this bracketed expression to the term 7 (3x + 5y + z) + 7 When representing a polynomial as a difference of polynomials, the following rule must be followed. If the terms are in brackets after the minus sign, then these terms inside the brackets must be reversed. Let us return to the polynomial 3x + 5y + z + 7. Let's represent it as the difference of two polynomials. Let us bracket the polynomials 3x and 5y and z and 7, then combine them with a "minus" sign (3x + 5y) − (z + 7) But we see that the minus sign is followed by the bracketing of terms z and 7. So these terms need to be reversed. This should be done inside the brackets: (3x + 5y) − (−z − 7) When putting terms in brackets, we must make sure that the value of the new expression is identical to the previous expression. This explains the substitution of the signs of the terms inside the brackets. If we open brackets in expression (3x + 5y) - (-z - 7), we obtain the original polynomial 3x + 5y + z + 7. (3x + 5y) − (−z − 7) = 3x + 5y + z + 7 In general, when representing a polynomial as a sum or a difference, the following rules can be followed: If the brackets are preceded by a plus sign, all the terms inside the brackets are written with their own signs. If a minus sign is put before the brackets, all terms inside the brackets are written with opposite signs. Example 1. Represent the polynomial 3x4 + 2x3 + 5x2 − 4 as a sum of some binomials: (3x4 + 2x3) + (5x2 − 4) Example 2. Represent the polynomial 3x4 + 2x3 + 5x2 − 4 as a difference of some binomials: (3x4 + 2x3) − (−5x2 + 4) There was a minus in front of the second brackets, so the terms 5x2 and −4 were written with opposite signs. Polynomial and its standard form A polynomial, like a monomial, can be reduced to the standard form. This results in a simplified polynomial that is easy to work with. To reduce a polynomial to the standard form, you need to reduce like terms in it. Like terms of a polynomial are terms that have the same letter part. Let us reduce the polynomial 2x + 4xy2 + x − xy2 to the standard form. To do this, we give its like terms. Like terms in this polynomial are 2x and x, as well as 4xy2 and -xy2. As a result, we got a polynomial 3x + 3xy2 that has no like terms. This form of a polynomial is called a standard form polynomial. Like a monomial, a polynomial has a power. To determine the degree of a polynomial, first reduce it to the standard form, then choose the monomial whose power is the largest of all. In the previous example we reduced the polynomial 2x + 4xy2 + x - xy2 to the standard form. The result is the polynomial 3x + 3xy2. It consists of two monomials. The power of the first monominant is 1, and the power of the second monominant is 3. The largest of these powers is 3. So the polynomial 3x + 3xy2 is a polynomial of degree 3. Since the polynomial 3x + 3xy2 is identically equal to the previous polynomial 2x + 4xy2 + x - xy2, this previous polynomial is also a third power polynomial. The power of a polynomial of the standard form is the greater of the powers of its constituent monomials.. In some polynomials, you first need to reduce the monomials in the polynomial to the standard form, and only then reduce the polynomial itself to the standard form. For example, let us reduce the polynomial 3xx4 + 3xx3 − 5x2x3 − 5x2x to the standard form. This polynomial consists of monomials that are not reduced to the standard form. First, we reduce them to the standard form: 3xx4 + 3xx3 − 5x2x3 − 5x2x = 3x5 + 3x4 − 5x5 − 5x3 Now the resulting polynomial 3x5 + 3x4 − 5x5 − 5x3 can be reduced to the standard form. To do this we give its like terms. Like terms are 3x5 and -5x5. There are no more like terms. The terms 3x4 and -5x3 will be rewritten without change: 3xx4 + 3xx3 − 5x2x3 − 5x2x = 3x5 + 3x4 − 5x5 − 5x3 = −2x5 + 3x4 − 5x3 Example 2. The polynomial 3ab + 4cc + ab + 3c2 should be reduced to the standard form. First, we reduce the monomial 4cc of the initial polynomial to the standard form and obtain 4c2 3ab + 4cc + ab + 3c2 = 3ab + 4c2 + ab + 3c2 The following is a list of like terms: 3ab + 4cc + ab + 3c2 = 3ab + 4c2 + ab + 3c2 = 4ab + 7c2 Example 3. Reduce the polynomial 4x2 − 4y − x2 + 17y − y to the standard form. Like terms in this polynomial are 4x2 and -x2, and -4y, 17y, and -y. Let us give them: 4x2 − 4y − x2 + 17y − y = 3x2 + 12y You can use brackets to connect like terms. To do this, put similar terms in brackets, then combine the expressions in brackets with a "plus" sign. Solve the previous example using brackets. Like terms in it were 4x2 and -x2, as well as -4y, 17y, and -y. We conclude them in brackets and combine them with a "plus" sign 4x2 − 4y − x2 + 17y − y = (4x2 − x2) + (−4y + 17y − y) Now in brackets let's perform the reduction of like terms: 4x2 − 4y − x2 + 17y − y = (4x2 − x2) + (−4y + 17y − y) = (3x2) + (12y) In the resulting expression (3x2) + (12y) open the brackets: 4x2 − 4y − x2 + 17y − y = (4x2 − x2) + (−4y + 17y − y) = (3x2) + (12y) = 3x2 + 12y Of course, this approach overloads the expression, but it minimizes errors. Example 4. Reduce the polynomial 12x2 − 9y − 9x2 + 6y + y to the standard form. Bracket like terms and combine them with a plus sign 12x2 − 9y − 9x2 + 6y + y = (12x2 − 9x2) + (−9y + 6y + y) Next, we calculate the contents of the brackets: 12x2 − 9y − 9x2 + 6y + y = (12x2 − 9x2) + (−9y + 6y + y) = (3x2) + (−2y) Get rid of the brackets by opening them: 12x2 − 9y − 9x2 + 6y + y = (12x2 − 9x2) + (−9y + 6y + y) = (3x2) + (−2y) = 3x2 − 2y Changing the order of members Consider a binomial x - y. How can we make the -y term come first and the x term second? A polynomial is the sum of monomials. That is, the original x - y binomial is the sum of x and -y x + (−y) The sum does not change by interchanging the places of the summands. Then x and -y can be swapped −y + x Example 2. Swap the terms in the -y - x binomial. The binomial -y - x is the sum of the terms -y and -x −y + (−x) Then according to the permutative law of addition we obtain (-x) + (-y). Let us get rid of the brackets: −x − y Thus, the solution can be written in a shorter form: −y − x = −x − y Example 3. Order the terms of the polynomial x + xy3 − x2 in descending order of powers. The term xy3 has the highest power in this polynomial, then -x2, and then x. Write them down in this order: x + xy3 − x2 = xy3 − x2 + x Multiplication of a monomial by a polynomial A monomial can be multiplied by a polynomial. To multiply a monomial by a polynomial, multiply that monomial by each term of the polynomial and add the products obtained. For example, multiply a monomial 3x2 by a polynomial 2x + y + 5. When multiplying a monomial by a polynomial, the latter must be bracketed: 3x2(2x + y + 5) Now multiply the monomial 3x2 by each term of the polynomial 2x + y + 5. The resulting products will be added: 3x2(2x + y + 5) = 3x2 × 2x + 3x2 × y + 3x2 × 5 Let's calculate the resulting products: 3x2(2x + y + 5) = 3x2 × 2x + 3x2 × y + 3x2 × 5 = 6x3 + 3x2y + 15x2 Thus, multiplying a monomial 3x2 by a polynomial 2x + y + 5 results in a polynomial 6x3 + 3x2y + 15x2. It is desirable to perform multiplication in mind. That way the solution is shorter: 3x2(2x + y + 5) = 6x3 + 3x2y + 15x2 In some examples, the monomial is placed after the polynomial. In this case, again, each term of the polynomial must be multiplied with the monomial and the resulting products must be added. For example, the previous example might have been given in the following form: (2x + y + 5) × 3x2 In this case we would multiply each term of the polynomial (2x + y + 5) by the monomial 3x2 and add the results: (2x + y + 5) × 3x2 = 2x × 3x2 + y × 3x2 + 5 × 3x2 = 6x3 + 3x2y + 15x2 The multiplication of a monomial by a polynomial (or the multiplication of a polynomial by a monomial) is based on the distributive law of multiplication. a(b + c) = ab + ac That is, to multiply the number a by the sum b + c, you need to multiply the number a by each summand of the sum b + c, and add the products obtained. In general, the multiplication of a monomial by a polynomial, and the distributive law of multiplication have a geometric meaning. Suppose there is a rectangle with sides a and b Increase the side of b by c Let's complete the missing side and paint the resulting rectangle for clarity: Now calculate the area of the resulting large rectangle. It includes yellow and gray rectangles. To calculate the area of the resulting large rectangle, you can separately calculate the areas of the yellow and gray rectangles and add up the results. The area of the yellow rectangle is ab, and the area of the gray rectangle is ac ab + ac This is like multiplying the length of a large rectangle by its width. The length in this case is b + c, and the width is a (b + c) × a or width multiplied by length to arrange the letters a, b, and c in alphabetical order: a × (b + c) Thus, the expressions a × (b + c) and ab + ac are equal to the same value (the same area) a × (b + c) = ab + ac For example, suppose we have a rectangle 4 cm long and 2 cm wide, and we increase the length by 2 cm Then the area of this rectangle is 2 × (4 + 2) or the sum of the areas of the yellow and gray rectangles: 2 × 4 + 2 × 2. The expressions 2 × (4 + 2) and 2 × 4 + 2 × 2 are equal to the same value 12 2 × (4 + 2) = 12 2 × 4 + 2 × 2 = 12 Therefore, 2 × (4 + 2) = 2 × 4 + 2 × 2 = 12. Indeed, the resulting large rectangle contains twelve square centimeters: Example 2. Multiply the monomial 2a by the polynomial a2 - 7a - 3 Multiply the monomial 2a by each term of the polynomial a2 - 7a - 3 and add the products obtained: 2a(a2 − 7a − 3) = 2a × a2 + 2a × (−7a) + 2a × (−3) = 2a3 + (−14a2) + (−6a) = 2a3 − 14a2 − 6a Or shorter: 2a(a2 − 7a − 3) = 2a3 − 14a2 − 6a Example 3. Multiply the monomial -a2b2 by the polynomial a2b2 − a2 − b2 Multiply the monomial -a2b2 by each term of the polynomial a2b2 − a2 − b2 and add the products obtained: Or shorter: Example 4. Perform multiplication −1.4x2y6(5x3y − 1,5xy2 − 2y3) Multiply the monomial -1.4x2y6 by each term of the polynomial 5x3y − 1,5xy2 − 2y3 and add the products obtained: Or shorter: Example 5. Perform multiplication Multiply the monomial by each term of the polynomial and add the products obtained: Or shorter: When performing short solutions, the results are written one after the other along with the sign of the resulting term. Let's take a step-by-step look at how the short solution to this example was performed. First, the monomial must be multiplied by the first term of the polynomial , that is, by . We get the result . The multiplication is done in mind. The result is . In the original expression we put an equal sign and write down the first result: After that, no signs can be placed in the original expression. You must immediately proceed to the next multiplication. The next step is to multiply the monomial by the second term of the polynomial , that is, by . We get the result . This result is positive, i.e. with a plus sign . In the original expression this result is written together with this plus sign right after the term After that, no signs can be placed in the original expression. You must immediately proceed to the next multiplication. The next step is to multiply the monomial by the third term of the polynomial , that is, by . The result is . This result is negative, that is, with a minus sign. In the original expression, this result is written together with its minus right after the term Sometimes there are expressions in which you must first multiply a monomial by a polynomial and then again by a monomial. For example: 2(a + b)c In this example, the term 2 is first multiplied by the polynomial (a + b), then the result is multiplied by c. First, multiply 2 by (a + b) and put the result in brackets 2(a + b)c = (2a + 2b)c The brackets indicate that the result of multiplying 2 by (a + b) is completely multiplied by c. If we had not bracketed 2a + 2b, we would have obtained the expression 2a + 2b × c, in which only 2b is multiplied by c. This would have changed the value of the original expression, and this is unacceptable. So we got (2a + 2b)c. Now we multiply the polynomial (2a + 2b) by the monomial c and get the final result: 2(a + b)c = (2a + 2b)c = 2ac + 2bc Multiplication could also be done by first multiplying (a + b) by c and multiplying the result with the term 2 2(a + b)c = 2(ac + bc) = 2ac + 2bc In this case, the commutative law of multiplication comes into play, which says that if an expression consists of several factors, then the product will not depend on the order of operations: a × b × c = (a × b) × c = a × (b × c) That is, the multiplication can be done in any order. This will not change the value of the original expression. Multiplication of a polynomial by a polynomial To multiply a polynomial by a polynomial, multiply each term of the first polynomial by each term of the second polynomial and add the products obtained. For example, multiply a polynomial x + 3 by y + 4 Bracket each polynomial and join them with the multiplication sign × (x + 3) × (y + 4) Or write them one after another without the × sign. This will also mean multiplication: (x + 3)(y + 4) Now multiply each term of the first polynomial (x + 3) by each term of the second polynomial (y + 4). Here again the distributive law of multiplication will be applied: (a + b)c= ac + bc The difference is that instead of the variable c we have a polynomial (y + 4) consisting of terms y and 4. Our problem is to multiply (x + 3) first by y, then by 4. To make no mistake, we can pretend that term 4 doesn't exist at all yet. To do that, we can cover it with our hand: We get the usual multiplication of a polynomial by a monomial. Namely, the multiplication of a polynomial (x + 3) by a monomial y. Let us perform this multiplication: (x + 3)(y + 4) = xy + 3y We have multiplied (x + 3) by y. Now it remains to multiply (x + 3) by 4. To do this, multiply each term of the polynomial (x + 3) by the monomial 4. This time in the original expression (x + 3)(y + 4) hand over y, since we already multiplied the polynomial (x + 3) by it We obtain the multiplication of the polynomial (x + 3) by the monomial 4. Let us perform this multiplication. The multiplication must be continued in the original example (x + 3)(y + 4) = xy + 3y (x + 3)(y + 4) = xy + 3y + 4x + 12 Thus, multiplying a polynomial (x + 3) by a polynomial (y + 4) results in a polynomial xy + 3y + 4x + 12. Another way to multiply a polynomial by a polynomial is to multiply each term of the first polynomial by the second polynomial as a whole and add the products obtained. Solve the previous example using this method. Multiply each term of the polynomial x + 3 by the whole polynomial y + 4 and add the products obtained: (x + 3)(y + 4) = x(y + 4) + 3(y + 4) As a result, we come to the multiplication of a monomial by a polynomial, which we studied earlier. Let's perform this multiplication: (x + 3)(y + 4) = x(y + 4) + 3(y + 4) = xy + 4x + 3y + 12 The result will be the same as before, but the terms of the resulting polynomial will be arranged slightly differently. Multiplication of a polynomial by a polynomial makes geometric sense. Suppose there is a rectangle with length a and width b The area of this rectangle is a × b. Increase the length of the rectangle by x and the width by y Let's finish the missing sides and paint the resulting rectangles for clarity: Now calculate the area of the resulting large rectangle. To do this, separately calculate the area of each rectangle included in the big rectangle and sum the results. The area of the yellow rectangle is ab, the area of the gray one is xb, the area of the purple one is ay, the area of the pink one is xy ab + xb + ay + xy And this is like multiplying the length of the resulting large rectangle by its width. The length in this case is a + x, and the width is b + y (a + x)(b + y) That is, the expressions (a + x)(b + y) and ab + xb + ay + xy are identically equal (a + x)(b + y) = ab + xb + ay + xy Suppose we had a rectangle that was 6 cm long and 3 cm wide, and we increased its length by 2 cm and width by 1 cm. Let's finish the missing sides and paint the resulting rectangles for clarity: The area of the resulting large rectangle is (6 + 2)(3 + 1) or the sum of the areas of the rectangles included in the large rectangle: 6 × 3 + 2 × 3 + 6 × 1 + 2 × 1. In both cases we obtain the same result 32 (6 + 2)(3 + 1) = 32 6 × 3 + 2 × 3 + 6 × 1 + 2 × 1 = 32 Therefore, (6 + 2)(3 + 1) = 6 × 3 + 2 × 3 + 6 × 1 + 2 × 1 = 18 + 6 + 6 + 2 = 32 Indeed, the resulting large rectangle contains thirty-two square centimeters: Example 2. Multiply a polynomial a + b by c + d Put the original polynomials in brackets and write them one after another: (a + b)(c + d) Now multiply each term of the first polynomial (a + b) by each term of the second polynomial (c + d) (a + b)(c + d) = ac + bc + ad + bd Example 4. Perform multiplication (−x − 2y)(x + 2y2) Now multiply each term of the first polynomial (−x − 2y) by each term of the second polynomial (x + 2y2) (−x − 2y)(x + 2y2) = −x2 − 2xy − 2xy2 − 4y3 The result of multiplication of terms should be written together with the signs of these terms. Consider step by step how this example was solved. So, we need to multiply the polynomial (-x - 2y) by the polynomial (x + 2y2). First multiply the polynomial (-x - 2y) by the first term of the polynomial (x + 2y2), that is, by x. Multiply -x by x, and you get -x2. In the original expression (-x - 2y)(x + 2y2) put an equal sign and write -x2 (−x − 2y)(x + 2y2) = −x2 After that, no signs can be placed in the original expression. We must immediately proceed to the next multiplication. Namely, multiply -2y by x . The result is -2xy. This result is negative, that is, with a minus sign. In the original expression, write the result -2xy right after the term -x2 (−x − 2y)(x + 2y2) = −x2 − 2xy Now multiply the polynomial (-x - 2y) by the second term of the polynomial (x + 2y2), i.e. by 2y2 Multiply -x by 2y2 to get -2xy2. In the original expression, write this result right after the term -2xy (−x − 2y)(x + 2y2) = −x2 − 2xy − 2xy2 We proceed to the next multiplication. Namely, multiplying -2y by 2y2. We obtain -4y3. In the original expression, write this result together with its minus right after the term -2xy2 (−x − 2y)(x + 2y2) = −x2 − 2xy − 2xy2 − 4y3 Example 5. Multiply (4a2 + 2ab − b2)(2a − b) Multiply each term of the polynomial (4a2 + 2ab − b2) by each term of the polynomial (2a - b) In the resulting expression, you can give like terms: Example 6. Perform multiplication -(a + b)(c - d) This time there is a minus in front of the brackets. This minus is the coefficient -1. That is, the original expression is the product of three factors: -1, polynomial (a + b), and polynomial (c - d). −1(a + b)(c − d) According to the combinative law of multiplication, if an expression consists of several factors, it can be calculated in any order. So you can first multiply the polynomials (a + b) and (c - d) and multiply the resulting polynomial by -1. The multiplication of polynomials (a + b) and (c - d) should be done in brackets −1(a + b)(c − d) = −1(ac + bc − ad − bd) Now multiply -1 and the polynomial (ac + bc - ad - bd). As a result, all terms of the polynomial (ac + bc - ad - bd) will change their signs to the opposite: −1(a + b)(c − d) = −1(ac + bc − ad − bd) = −ac − bc + ad + bd Or you could multiply -1 with the first polynomial (a + b) and multiply the result with the polynomial (c - d) −1(a + b)(c − d) = (−a − b)(c − d) = −ac − bc + ad + bd Example 7. Perform multiplication x2(x + 5)(x − 3) First multiply the polynomials (x + 5) and (x - 3), then multiply the resulting polynomial with x2 Example 8. Perform multiplication (a + 1)(a + 2)(a + 3) First multiply the polynomials (a + 1) and (a + 2), then multiply the resulting polynomial with the polynomial (a + 3) So, multiply (a + 1) and (a + 2) Multiply the resulting polynomial (a2 + a + 2a + 2) with (a + 3) If the fast multiplication of polynomials is difficult at first, you can use the detailed solution, the essence of which is to write down how each term of the first polynomial is multiplied by the whole second polynomial. Such a notation, although it takes a lot of space, keeps errors to a minimum. For example, multiply (a + b)(c + d) Let us write down how each term of a polynomial a + b is multiplied by the whole polynomial c + d. As a result, we come to the multiplication of a monomial by a polynomial, which is easier to perform: (a + b)(c + d) = a(c + d) + b(c + d) = ac + ad + bc + bd This notation is convenient when multiplying a binomial by some polynomial that contains more than two terms. For example: (x + y)(x2 + 2xy + y2) = x(x2 + 2xy + y2) + y(x2 + 2xy + y2) = x3 + 2x2y + xy2 + x2y + 2xy2 + y3 = x3 + 3x2y + 3xy2 + y3 Or when multiplying polynomials with more than two terms. For example, multiply a polynomial x2 + 2x - 5 by a polynomial x3 - x + 2 (x2 + 2x − 5)(x3 − x + 2) Write the multiplication of the original polynomials as a multiplication of each term of the polynomial x2 + 2x - 5 by the polynomial x3 - x + 2. We obtained the usual multiplication of monomials by polynomials. Let us perform these multiplications: In the resulting polynomial we give like terms: Arrange the monomials in the resulting polynomial in descending order of powers. It is not necessary to do this. But such a notation will be more beautiful: Putting the common factor out of brackets We have already learned how to put the common factor behind brackets in simple alphabetic expressions. Now we will go a little deeper into this topic and learn how to put the common factor out of brackets in a polynomial. The principle will be the same as in a simple letter expression. Only polynomials consisting of powers will cause some difficulties. Consider a simple binomial 6xy + 3xz. Put the common factor out of brackets. In this case the common factor 3x can be put out of brackets. Recall that if the common factor is put out of brackets, each summand of the original expression must be divided by this common factor: Or shorter: The result is 3x(2y + z). In this case another simpler polynomial (2y + z) is formed in brackets. The common factor that is taken out of brackets is chosen so that the brackets contain terms that do not contain a common literal factor, and the coefficient modules of these terms have no common divisor except one. That is why in the above example the common factor 3x was put out of brackets. A polynomial 2y + z whose coefficient modules have no common divisor except unity is formed in brackets. This requirement can be fulfilled by finding the greatest common divisor (GCD) of the coefficient modules of the original terms.This GCD becomes the coefficient of the common factor to be taken out of brackets. In our case, the original polynomial was 6xy + 3xz. The coefficients of the original terms are 6 and 3, and their GCD is 3. And the letter part of the common factor is chosen so that the terms in brackets do not have common letter factors. In this case, this requirement was easily met. The common letter factor was visible to the naked eye - it was the x factor. Example 2. Put outside the brackets the common factor in the polynomial x2 + x + xy All terms of this polynomial have a quotient of one. The greatest common divisor of the moduli of these units is one. Therefore the numerical part of the bracketed factor will be one. But one is not written as a coefficient. Next, we choose the letter part of the common factor. First of all, we must understand that any term included in a polynomial is a monomial. And a monomial is the product of numbers, variables, and powers. Even if the term of a polynomial is an ordinary number, it can always be represented as a product of one and the number itself. For example, if a polynomial contains the number 5, it can be represented as 1 × 5. If a polynomial contains a number 8, it can be represented as a product of multipliers 2 × 2 × 2 (or as 2 × 4) The situation is the same with variables. If a polynomial contains a term that is a variable or a degree, it can always be represented as a product. For example, if a polynomial contains a monomial term x, it can be represented as a product of 1 × x. If a polynomial contains a monomial term x3, it can be represented as a product of xxx. The monomials that make up the polynomial x2 + x + xy can be decomposed into factors so that we can see the alphabetic factor that is common to all the terms. So, the first term of the polynomial x2 + x + xy, namely x2 can be represented as a product of x × x. The second term x can be represented as 1 × x. Leave the third term xy unchanged, or for clarity rewrite it with the multiplication sign x × y Translated with www.DeepL.com/Translator (free version) Each term of a polynomial is represented as a product of factors of which these terms consist. It is easy to see that in all three products the common factor is x. Let us distinguish it: This factor x is taken out of brackets. If you put the common factor out of brackets, divide each term of the original expression by this common factor. In our case each term of the polynomial x × x + 1 × x + x × y should be divided by the common factor x So, if you put the common factor out of brackets in the polynomial x2 + x + xy, you get x(x + 1 + y) Or shorter: As a result, the brackets contain terms that have no common literal factors, and the moduli of the coefficients of these terms have no common divisors except 1. Example 2. Put the common factor out of brackets in the 15x2y3 + 12xy2 + 3xy2 polynomial Determine the coefficient of the common factor taken out of brackets. The greatest common divisor of the moduli of coefficients 15, 12, and 3 is number 3. So, the number 3 is the coefficient of the common factor to be taken out of the brackets. Now determine the letter part of the common factor to be taken out of brackets. It must be chosen so that the terms that do not contain a common letter factor remain in the brackets. Let us rewrite the letter parts of the original polynomial 15x2y3 + 12xy2 + 3xy2 as a factorization. This will allow us to see well what can be taken out of the brackets: We see that the common factor among the letter parts is xyy, that is, xy2. If we take this factor out of brackets, the brackets leave a polynomial without a common letter factor. As a result, the common factor taken out of the brackets will be the factor 3xy2 Or shorter: To check, you can multiply 3xy2(5xy + 4 + 1). The result should be a polynomial 15x2y3 + 12xy2 + 3xy2 3xy2(5xy + 4 + 1) = 3xy2 × 5xy + 3xy2 × 4 + 3xy2 × 1 = 15x2y3 + 12xy2 + 3xy2 Example 3. Put the common factor outside the brackets in the expression x2 + x In this case you can put x This is because the first term x2 can be represented as xx. And the second term x can be represented as 1 × x x2 + x = xx + 1 × x It is not necessary to write out in detail the contents of each term by decomposing it into multipliers. This is easily done in your mind. Example 4. Put the common factor out of brackets in the polynomial 5y2 − 15y In this case 5y can be taken out of brackets. The greatest common divisor of the moduli of coefficients 5 and 15 is number 5. Among the letter factors, the common factor is y Example 5. Put the common factor out of brackets in the polynomial 5y2 − 15y3 In this example, 5y2 can be taken out of brackets. The greatest common divisor of the moduli of coefficients 5 and 15 is number 5. Among the letter factors, the common factor is y2 Example 6. Put the common factor out of brackets in the polynomial 20x4 − 25x2y2 − 10x3 In this example, 5x2 can be taken out of brackets. The greatest common divisor of the moduli of the coefficients 20, -25, and -10 is number 5. Among the letter multipliers, the common factor is x2 Example 7. Put the common factor out of brackets in the polynomial am + am + 1 The second term am + 1 is the product of am and a, since am × a = am + 1 Replace the term am + 1 in the original example with the identically equal product am × a. This makes it easier to see the common factor: Now we can see that the common factor is am. We will put it out of brackets: Checking for Identity Solving a task with polynomials sometimes stretches over several lines. Each following transformation must be identically equal to the previous one. If you have doubts about the correctness of your actions, you can substitute arbitrary values of variables in the original and obtained expression. If the original expression and the resulting expression are equal to the same value, you can be sure that the task has been solved correctly. Suppose we need to take the common factor out of brackets in the next polynomial: 2x + 4x2 In this case you can take the common multiplier 2x out of the brackets 2x + 4x2 = 2x(1 + 2x) Suppose we are not sure about such a solution. In this case, take any value of the variable x and substitute it first into the original expression 2x + 4x2, then into the resulting 2x(1 + 2x). If the result is the same in both cases, it means that the task is solved correctly. Take an arbitrary value of x and substitute it into the original expression 2x + 4x2. Let x = 2. Then we get: 2x + 4x2 = 2 × 2 + 4 × 22 = 4 + 16 = 20 Now substitute the value of 2 into the transformed expression 2x(1 + 2x) 2x(1 + 2x) = 2 × 2 × (1 + 2 × 2) = 4 × 5 = 20 That is, when x = 2 the expressions 2x + 4x2 and 2x(1 + 2x) are equal to the same value. This means that the task was solved correctly. The same will happen for other values of the variables x. For example, check our solution when x = 1 2x + 4x2 = 2 × 1 + 4 × 12 = 2 + 4 = 6 2x(1 + 2x) = 2 × 1 × (1 + 2 × 1) = 2 × 3 = 6 Example 2. Subtract from the polynomial 5x2 - 3x + 4 the polynomial 4x2 - x and check the result by substituting an arbitrary value for the variable x. Perform the subtraction: We performed two transformations: first we opened the brackets, and then we gave like terms. Now let us check these two transformations for identity. Let x = 2. Let us first substitute this value in the original expression and then in the transformed ones: We see that for each transformation the value of the expression at x = 2 did not change. This means that the task was solved correctly. Tasks for independent decision Task 1. Add polynomials 8x + 11 and 7x + 5 Solution: (8x + 11) + (7x + 5) = 8x + 11 + 7x + 5 = 15x + 16 Task 2. Subtract from the polynomial 8x + 11 the polynomial 7x + 5 Solution: (8x + 11) − (7x + 5) = 8x + 11 − 7x − 5 = x + 6 Task 3. Perform addition 8a + (3b + 5a) Solution: 8a + (3b + 5a) = 8a + 3b + 5a = 13a + 3b Task 4. Perform addition Solution: Task 5. Perform addition Solution: Task 6. Perform addition Solution: Task 7. Convert the following polynomial to the standard form: Solution: Task 8. Convert the following polynomial to the standard form: Solution: Task 9. Simplify the following expression: Solution: Task 10. Simplify the following expression: Solution: Task 11. Simplify the following expression: Solution: Task 12. Represent the polynomial 5a2 - 2a - 3ab + b2 as the sum of two terms, one of which is $5a^2$ - 2a Solution: 5a2 − 2a − 3ab + b2 = (5a2 − 2a) + (−3ab + b2) Task 13. In the polynomial 2x3 + 5x2y − 4xy2 − y3, bracket the outermost terms with a plus sign (+) before them, and bracket the middle terms with a minus sign (-) before them. Solution: 2x3 + 5x2y − 4xy2 − y3 = (2x3 − y3) − (−5x2y + $4xy^2$) Task 14. Without changing the value of the expression 2a3 − 3a2b + 3ab2 − b3, put it in brackets and put a sign (-) before the brackets. Solution: 2a3 − 3a2b + 3ab2 − b3 = −(−2a3 + 3a2b − 3ab2 + b3) Task 15. Represent the trinomial 2a - b + 4 as the difference of two expressions with the minuendum 2a Solution: 2a − b + 4 = 2a − (b − 4) Task 16. Give like terms in the following polynomial: Solution: Task 17. Perform the multiplication of a monomial by a polynomial: Solution: Task 18. Perform the multiplication of a monomial by a polynomial: Solution: Task 19. Perform the multiplication of a monomial by a polynomial: Solution: Task 20. Perform the multiplication of a monomial by a polynomial: Solution: Task 21. Perform the multiplication of a monomial by a polynomial: Solution: Task 22. Perform the multiplication of a monomial by a polynomial: Solution: Task 23. Perform the multiplication of a monomial by a polynomial: Solution: Task 24. Perform the multiplication of a monomial by a polynomial: Solution: Task 25. Perform the multiplication of a monomial by a polynomial: Solution: Task 26. Perform the multiplication of a polynomial by a polynomial: Solution: Task 27. Perform the multiplication of a polynomial by a polynomial: Solution: Task 28. Perform the multiplication of a polynomial by a polynomial: Solution: Task 29. Perform the multiplication of a polynomial by a polynomial: Solution: Task 30. Perform the multiplication of a polynomial by a polynomial: Solution: Task 31. Perform the multiplication of a polynomial by a polynomial: Solution: Task 32. Perform the multiplication of a polynomial by a polynomial: Solution: Task 33. Perform the multiplication of a polynomial by a polynomial: Solution: Task 34. Perform the multiplication of a polynomial by a polynomial: Solution: Task 35. Perform the multiplication of a polynomial by a polynomial: Solution: Task 36. In the polynomial 6a + 12, take the common factor out of the brackets. Solution: 6a + 12 = 6(a + 2) Task 37. In the polynomial 5mn − 5m, take the common factor out of the brackets. Solution: 5mn − 5m = 5m(n − 1) Task 38. In the polynomial x3 − x2, take the common factor out of the brackets. Solution: x3 − x2= x2(x − 1) Task 39. In the polynomial 3x2 − 6x3, take the common factor out of the brackets. Solution: 3x2 − 6x3= 3x2(1 − 2x) Task 40. In the polynomial x4 − x2, take the common factor out of the brackets. Solution: x4 − x2 = x2(x2 − 1) Task 41. In the polynomial x2y − xy2, take the common factor out of the brackets. Solution: x2y − xy2= xy(x − y) Task 42. In the polynomial a3b2 + a2b3, take the common factor out of the brackets. Solution: a3b2 + a2b3 = a2b2(a + b) Task 43. In the polynomial a8b2 + ab4, take the common factor out of the brackets. Solution: a8b2 + ab4= ab2(a7 + b2) Task 44. Take the common factor out of the brackets in the following polynomial: Solution: Task 45. Take the common factor out of the brackets in the following polynomial: Solution: Task 46. Take the common factor out of the brackets in the following polynomial: Solution: Task 47. Take the common factor out of the brackets in the following polynomial: Solution: Task 48. Take the common factor out of the brackets in the following polynomial: Solution: Task 49. Take the common factor out of the brackets in the following polynomial: Solution: Task 50. Take the common factor out of the brackets in the following polynomial: Solution: Task 51. Take the common factor out of the brackets in the following polynomial: Solution: Task 52. Take the common factor out of the brackets in the following polynomial: Solution: Task 53. Take the common factor out of the brackets in the following polynomial: Solution: Task 54. Take the common factor out of the brackets in the following polynomial: Solution: