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The answer to multiplication problem called

Congratulations. You have a handle for addition and de-use. It's time to move on to the next level in arithmetic. Multiplication will seem easy for you. Multiplication is basically an addition that is repeated over and over again. Appendix: 3 + 3 + 3 + 3 + 3 = 15 Multiplication: 5 x 3 = 15 Instead of writing out several additions in a long addition problem, we can group them and multiply them. That's it. You can quickly add multiple groups. You can use multiplication to find out how many pages are in a book with ten (10) chapters. You can also use multiplication to find out the thickness of the book if you know the thickness of one page. Configure the multiplication problem for values that multiply are called factors. The answer to the multiplication problem is called the product. The product can be found by multiplying two or any number of factors. There are many symbols used in multiplication. Your basic work will use x (x). This is called the symbol of the times. If you read the problem of multiplying aloud in front of a class, you would say: Twice two equals four. When you write numbers, you get 2 x 2 = 4. Example: Twenty-five times sixty-eight equals a thousand seven hundred. 25 x 68 = 1700 Factors: 25 and 68 Product: 1700 We like to start small, so let's look at the numbers from 1 (1) to ten (10). Here are some examples of using number two (2). 2 x 1 = 2 (one set of two equals two: 2 = 2) 2 x 2 = 4 (two sets of two equal to four: 2 + 2 = 4) 2 x 3 = 6 (three sets of two equal to six 2 + 2 + 2 = 6) 2 x 4 = 8 (four sets of two equal to eight: 2 + 2 + 2 + 2 = 8) 2 x 5 = 10 (five sets of two equal to ten : 2 + 2 + 2 + 2 + 2 = 10) 2 x 6 = 12 (2 + 2 + 2 + 2 + 2 + 2 = 12) 2 x 27 = 14 (2 + 2 + 2 + 2 + 2 + 2 + 2 = 14) 2 x 8 = 16 (2 + 2 + 2 + 2 + 2 + 2 2 2 + 2 = 16) 2 x 9 = 18 (2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 = 20) Do you see patterns? Can you see how multiplication makes it easier to write numbers in a math problem? As for this, it does everything that the supplement (over and over) is a waste of time. You need to memorize the table that is the core of multiplication. Sorry for that, but you will have to memorize some values here. In the same way you learned the basics of adding and adding numbers from 1-10, you need to do the same for multiplication. There's not much we can do, but show you a table. The numbers at the top and left of the grid are two numbers that you want to multiply. The answer (product) is in a grid where two lines intersect. We'll talk more about it on other pages, but here's the basic chart. In the chart we distinguish four times nine (4 x 9). When you look along the chart you can see that 4 x 9 = 36. ► NEXT PAGE ON ARITHMETIC ► BACK TO TOP OF PAGE ► Or search pages ... this article is about a mathematical operation. For other uses, see Multiplication (discrimination). Arithmetic operation This article requires additional citations for verification. Help improve this article by adding quotes to reliable sources. Uns out-of-commissioned materials may be challenged and removed. Find Sources: Multiplication News · newspapers · books · scholar · JSTOR (April 2012) (Find out how and when to delete this template message) Arithmetic term adding (+) term + summand + summand addend (broad sense) + addend (broad sense) augend + addend (strict sense) } = {\displaystyle \scriptstyle \left.{ \begin{matrix}\scriptstyle {\text{term}}\,+\,{\text{term}}\\\scriptstyle {\text{summand}}\,{{text{summand}}\\scriptstyle {\text{addend (broad sense)}}\,{{text{addend (broad sense)}}\style {\text{augend}}\,,+,{{text{addend (strict sense)}\end{matrix}}\right\}\ ,=,} sums {\displaystyle \scriptstyle {\text{sum}}} Subtrail term (−) term − minuend term − subtrahend } = {\displaystyle \scriptstyle \left.{ \begin{matrix}\scriptsty {\text{term}}\,,,{\text{term}\\scriptstyle {\text{minuend}}\,\,{\text{subtrahend}\end{matrix}}\right\}\,=,} difference {\displaystyle \scriptstyle {\text{difference}}} Multiplication factor (×) × multiplier × multiplicand } = {\displaystyle \scriptstyle \left.{ \begin{matrix}\scriptstyle {\text{factor}}\,\times \,{\text{factor}}\\scriptstyle {\text{multiplier}}\,\times \,{\text{multiplicand}}\end{matrix}}\right\}\ ,=\,} product {\displaystyle \scriptstyle {\text{product}}} Split (÷) dividend split denominator } = {\displaystyle \scriptstyle \left.{ \begin{matrix}\scriptstyle {\fra c {\scriptstyle {\text{dividend}}{\scriptstyle {\text{text{divisor}}}\\scriptstyle {\text{ }}\\scriptstyle {\frac {\scriptstyle {\text{counter }}}{\scriptstyle {\text{denominator}}}\end{matrix}}\right\}\,=\,} quot%start{matrix}\scriptstyle {\text{fraction}}\\\scripts style {\text{quotlost}\\scriptstyle {\text{ratio}}\end{matrix}}} Basic exponent exponent = {\displaystyle \scriptstyle {\text{base}}^{\text{exponent}}\ ,=\,} power {\displaystyle \scriptstyle {\text{power}}} nth root (√) radicand degree = {\displaystyle \scriptstyle {\sqrt[{\text{degree}}]{\scriptstyle {\text{radicand}}}\ _=\,} root {\displaystyle \scriptstyle {\text{root}}} Logarithm (log) (anti-logarithm) = {\displaystyle \scriptstyle \log _{\text{base}}({\\text{anti-logarithm}}},=\,} logarithm {\displaystyle \scriptstyle {\text{logarithm}}} Four bags with three balls per bag give twelve balls (4 × 3 = 12). You can also think of multiplication as scaling. Here we see 2 being multiplied by 3 using scaling, giving 6 as a result. Multiplication animation 2 × 3 = 6. 4 × 5 = 20. The large rectangle consists of 20 squares, each of which 1 on 1. Fabric area 4,5 m × 2,5 m = 11,25m2; 41/2 × 21/2 = 111/4 Multiplication (often marked with the cross symbol ×, by the centerline point operator (by juxtaposition or, on computers, asterisk *) is one of the four basic arithmetic mathematical operations, the others being addition, reautation and division. The result of a multiplication operation is called a product. Multiplication of whole numbers can be considered as repeated addition; that is, multiplying two numbers is equivalent to adding as many copies of one of them as possible, multiplicand, like the number of the other, multiplier. Both numbers can be referred to as factors. a × b = b + ⋯ + b ⏟ times {\displaystyle a\times b=\underbrace {b+\cdots +b} _{a{\text{ times}}}} For example, 4 multiplied by 3, often written as 3 × 4 {\displaystyle 3\times 4} and spoken as 3 times 4, you can calculate by adding 3 copies 4 together: 3 × 4 = 4 + 4 + 4 = 4 = 12 {\displaystyle 3\times 4=4+4=12} Here , 3 and 4 are factors, and 12 is a product. One of the main properties of multiplication is the property of speech, which states in this case that adding 3 copies 4 produces the same result as adding 4 copies 3: 4 × 3 = 3 + 3 + 3 = 3 = 12 {\displaystyle 4\times 3=3+3+3=12} Thus, the multiplier and multiplicand designation does not affect the multiplication result. [1] The multiplication of integers (including negative numbers), rational numbers (fractions) and real numbers is defined by the systematic generalisation of this basic definition. You can also visualize multiplication as counting objects arranged in a rectangle (for whole numbers) or as finding an area of a rectangle whose sides have certain lengths. The area of the rectangle does not depend on which page is measured first— the consequence of the alternate property. The product of two measurements is a new type of measurement. For example, multiplying the length of two sides of a rectangle gives it an area. Such products are the subject of dimensional analysis. The reverse multiplication operation is a division. For example, because 4 multiplied by 3 equals 12, 12 divided by 3 equals 4. Indeed, multiplying by 3 and then dividing by 3, gives the original number. A division of a number other than 0 in itself is equal to 1. Multiplication is also defined for other types of numbers, such as complex numbers and more abstract constructs, such as matrices. For some of these more abstract constructs, the order in which operas are multiplied together matters. A list of many different types of products used in mathematics is given in the product (mathematics). Notation and terminology See also: Multiplier (linguistics) Multiplication character × In arithmetic, multiplication is often written with × {\displaystyle \times } between terms in infix). [2] For example, 2 × 3 = 6 {\displaystyle 2\times 3=6} (twice three equals six) 3 × 4 = 12 {\displaystyl 3\times 4=12} 2 × 3 × 5 = 6 × 5 = 30 {\displaystyle 2\times 3\times 5 times =6\times 5=30} 2 × 2 × 2 × 2 × 2 = 32 {\displaystyle 2\times 2\times 2\times 2=32} The character is encoded in Unicode in U +00D7 × a multiplication character (HTML × · & time;). There are other mathematical entries for multiplication: Multiplication is also marked with period characters[3], usually a period after the middle position (rarely period): 5 - 2 or 5 . 3 Center point notation, encoded in Unicode as U+22C5 - DOT OPERATOR, is standard in the United States and other countries where this period is used as a decimal point. When a dot operator character is not available, a point (·) character is used. In the United Kingdom and Ireland, period/period is used for multiplication, and the middle dot is used for decimal point, although the use of a period/dot for a decimal point is common. In other countries that use a comma as a decimal character, a period or center dot is used for multiplication. [citation needed] In algebra, multiplication involving variables is often recorded as a statement (e.g. xy for x times y or 5x by five times x), also called implication. [4] Notation can also be used for the number surrounded by parentheses (e.g. 5(2) or (5)2) for five times two). This implicit use of multiplication can cause ambiguity when the combined variables match the name of another variable, when the variable name before the parenthesis can be confused with the function name or when the order of the operation is correctly determined. In vector multiplication, there is a distinction between a cross and dot symbols. The cross symbol usually means taking a cross product with two vectors, giving the vector as a result, while a period means taking dot the product of two vectors, resulting in scalar. In computer programming, an asterisk (as in 5 * 2) is still the most common notation. This is due to the fact that most computers have historically been limited to small character sets (such as ASCII and EBCDIC) that did not have a multiplication mark (× e.g. This use comes from the FORTRAN programming language. The numbers you want to multiply are usually called factors. The number to be multiplied is multiplicand, and the number by which it is multiplied is a multiplier. Typically, the multiplier is placed first, and multiplicand takes second place; [1] However, sometimes the first factor is multiplicand and the second is the multiplier. [5] Also as a result of multiplication does not depend on the order of factors, the distinction between multiplicand and multiplier is useful only in a very elementary and in some multiplication algorithms, such as long multiplication. Therefore, in some sources the term multiplicand is considered synonymous with the factor. [6] In algebra, a number that is a multiplier of a variable or expression (e.g. 3 in 3xy2) is called a coefficient. The result of multiplication is called a product. The product of an integer is a multiple of each factor. For example, 15 is product 3 and 5 and is both a multiple of 3 and a multiple of 5. Calculations Main article: Multiplication algorithm Educated monkey – tin toy from 1918, used as a multiplication of the calculator. For example: set the monkey's feet to 4 and 9, and get the product – 36 – in his hands. Common methods of multiplying numbers with pencil and paper require an array of multiplication of memorized or consulted products of small numbers (usually any two numbers from 0 to 9), but one method, peasant multiplication algorithm, no. Multiplying numbers to more than a few decimal places manually is tedious and error-prone. Typical logarithms were invented to simplify such calculations because adding logarithms is equivalent to multiplication. The slide rule allowed you to quickly multiply numbers to about three places of accuracy. Starting in the early 20th century, mechanical calculators, such as Marchant, automatically multiply to 10 digits. Modern electronic computers and calculators have greatly reduced the need for manual multiplication. Historical algorithms Methods of multiplication have been documented in the writings of ancient Egypt, Greek, Indian and Chinese Civilizations. The Bone of Ishango, dating from about 18,000 to 20,000 BC, may indicate knowledge of multiplication in the upper Paleolithic era in Central Africa, but it is speculative. Egyptians Main Article: Ancient Egyptian Multiplication Egyptian Method of Multiplying Integer and Fractions, documented in Ahmes Papyrus, was by successive additions and doubling. For example, to find product 13 and 21 you had to double 21 three times, getting 2 × 21 = 42, 4 × 21 = 2 × 42 = 84, 8 × 21 = 2 × 84 = 168. The full product can then be found by adding the corresponding terms found in the doubling sequence: 13 × 21 = (1 + 4 + 8) × 21 = (1 × 21) + (4 × 21) + (8 × 21) = 21 + 84 + 168 = 273. Babylonian Babylonians used a sexagesimal positional number system, analogous to the modern decimal day system. So Babylonian multiplication was very similar to modern decimal multiplication. Due to the relative difficulty of memorizing 60 × 60 different products, Babylonian mathematicians used multiplication tables. These tables consisted of a list of the first twenty multiples of the specified main number n: n, 2n, ..., 20n; followed by multiples of 10n: 30n 40n and 50n. Then calculate any sexagesimal say 53n, one needed only to add 50n and 3n calculated from the table. Chinese See also: Chinese multiplication table 38 × 76 = 2888 In the mathematical text of Zhoubi Suanjing, dating before 300 BC, and in nine chapters of mathematical art, multiplication calculations were written in words, although the first Chinese mathematicians used Rod's calculus to add space value, subdue, multiply and divide. The Chinese have already used the decimal table at the end of the Warring States period. [7] Modern methods Product 45 and 256. Notice that the order of digits in 45 is reversed down the left column. The multiplication transfer stage can be performed at the final stage of the calculation (in bold) by returning the final product 45 × 256 = 11520. This is a variant of grille multiplication. The modern method of multiplication based on the Hindu-Arabic numerical system was first described by Brahmagupta. Brahmagupta gave the principles of addition, deceit, multiplication, and division. Henry Burchard Fine, then professor of mathematics at Princeton University, wrote: Indians are the inventors not only of the positional decimal system itself, but of most of the processes involved in elementary counting of the system. Addition and reassuage performed fairly, as they are performed nowadays; multiplication have done in many ways, ours among them, but the division they have done cumbrously. Arithmetic algorithms with decimal points were introduced into Arab countries by Al Khwarizmi at the beginning of I I I IR, and popularized in the Western world by Fibonacci in the 13th century. The Grid Multiplication grid method, or box method, is used in primary schools in England and Wales and in some areas of the United States to help understand how multi-digit multiplication works. An example of multiplying 34 by 13 might be the position of numbers in a grid, such as: 30 4 10 300 40 3 90 12, and then adding entries. Computer algorithms Main article: Multiplication algorithm § Fast multiplication algorithms for large inputs The classic method of multiplying two-digit numbers requires the multiplication of n2 digits. Multiplication algorithms are designed to significantly reduce calculation time when multiplying large numbers. Methods based on Fourier's discrete transformation reduce computational complexity to O(n log n log log n). Recently, the log n factor has been replaced by a function that increases much more slowly, although it is still not constant (as you might expect). In March 2019, David Harvey and Joris van der Hoeven submitted an article outlining an algorithm for total multiplication with the declared complexity of O (n log n). {\displaystyle O(n\log n).} [10] The algorithm, also based on Fourier's rapid transformation, is Optimal. The algorithm is not considered practically useful, because its advantages appear only when multiplying very large numbers (having more than 2172912 bits). [12] Measurement products Main article: Dimensional analysis You can only significantly add or remove quantities of the same type, but quantities of different types can be easily multiplied or divided. For example, four bags with three beads each can be thought of as:[1] [4 bags] × [3 beads per bag] = 12 beads. When the two measurements are multiplied together, the product is type depending on the type of measurement. The general theory is given by dimensional analysis. This analysis is routinely used in physics, but it also has applications found in finance and other fields used. A typical example in physics is that multiplying speed over time gives you distance. For example: 50 kilometers per hour × 3 hours = 150 kilometers. In this case, the hourly units cancel, leaving the product only with kilometer units. Other examples of multiplication involving units are: 2.5 meters × 4.5 meters = 11.25 square meters 11 meters/second × 9 seconds = 99 meters 4.5 inhabitants per house × 20 houses = 90 inhabitants Sequence products Record Capital pi Product sequence factors can be saved with a product symbol, which comes from the uppercase letter ∏ {\displaystyle \textstyle \prod } (pi) in the Greek alphabet (similar to the uppercase letter ∑ {\displaystyle \textstyle \sum } (sigma) is used in the context of summation). [13] [14] [15] Unicode item U+220F (∏) contains a glyph for the determination of such a product, as opposed to the letter U+03A0 (Π). The meaning of this notation is given by: ∏ i = 1 4 i = 1 , 2 - 3 , 4 , {\displaystyle \prod _{i=1}^{4}i=1\cdot 2\cdot 3\cdot 4,} i.e. ∏ and = 1 4 and = 24. {\displaystyle \prod _{i=1}^{4}i=24.} The subscript gives a symbol of a bound variable (and in this case), called a multiplication index, along with its lower bound (1), while the superscript (here 4) gives an upper bound. The lower and upper bounds are expressions that indicate integers. Product factors are obtained by the expression following the product operator, with successive integer values substituted by the multiplication index, starting from the lower limit and incremented by 1 to (inclusive) the upper limit. For example: ∏ i = 1 6 i = 1 - 2 - 4 - 5 - 6 = 720 {\displaystyle \prod _{i=1}^{6}i=1\cdot 2\cdot 3\cdot 4\cdot 5\cdot 6=720} In general, notation is defined as ∏ i = m n x i = x m - x m + 1 - x m + 2 - ∏ ⋯ x_ x_ - x n − 1 - x n , {\displaystyle \prod _{i=m}^{n}x_{i}=x_{m}\cdot x_{m+1}\cdot x_ x_ {m+2}\cdot \,\,\cdots \,\,\cdot x_{n-1}\cdot x_{n},} where m and n are integers or expressions, which are total resetons. Where m = n, product is the same as for a single xm factor; if m > n, the product is an empty product with a value of 1, regardless of the factor expression. Properties

∏ i = 1 n x i = x 1 - x 2 ♠ ... - x n {\displaystyle \prod _{i=1}^{n}x_{i}=x_{1}\cdot x_{2}\cdot \ldots \cdot x_{n}} If all terms are identical, the product sequence is equivalent to exponential. ∏ i = 1 n x = x - x - ... - x = x {\displaystyle \prod _{i=1}^{n}x=x\cdot x\cdot \ldots \cdot x=x^{n}} ∏ and = 1 n e = e - e - ... - e = e n {\displaystyle \prod _{i=1}^{n}e=e\cdot e\cdot \ldots \cdot e=e^{n}} ∏ i = 1 n x and y i = (∏ i = 1 n x i) (∏ i = 1 n y i) = x 1 y 1 , x 2 y 2 ... - x n y n {\displaystyle \prod _{i=1}^{n}{x_{i}y_{i}}=left(\prod _{i=1}^{n}x_{i}\right)\left(\prod _{i=1}^{n}y_{i}\right)=x_{1}y_{1}\cdot x_{2}y_{2}\cdot \ldots \cdot x_{n}y_{n}} (∏ i = 1 n x i) a = ∏ i = 1 n x and a = x 1 a - x 2 a ... - x n a {\displaystyle \left(\prod _{i=1}^{n}x_{i}\ right)^{a}=\prod _{i=1}^{n}x_{i}{a}=x_{1}^{a}\cdot x_{2}^{a}\cdot \ldots \cdot x_{n}^{a}} ∏ i = 1 n e x i = e ∑ i = 1 n x and {\displaystyle \prod _{i=1}^{n}e^{x_{i}}=e^{\sum _{i=1}^{n}x_{and}}} : Infinite product You can also consider products with infinite multiple dates; they are called infinite products. Notationally, it replaces n above by the Infinity symbol ∞. The product of such an infinite sequence is defined as the product boundary of the first n terms, because n grows without restrictions. This means that ∏ i = m ∞ x i = lim n → ∞ ∏ i = m n x i . {\displaystyle \prod _{i=m}{\infty }x_{i}=\lim _{n\to \infty }\prod _{i=m}^{n}x_{i}.} Similarly, you can replace m with negative infinity, and define: ∏ i = − ∞ ∞ x i = (lim m → − ∞ ∏ i = m 0 x i) (lim n → ∞ ∏ i = 1 n x i) , {\displaystyle \prod _{i=\infty }^{\infty }x_{{{i}=\left(\lim _{m\to -\infty }\prod _{i=m}^{0}x_{i}\right)\cdot \left(\lim _{n\to \infty }\prod _{i=1}^{n}x_{and}\right) ,} provided that there are both limits. Multiplication properties 0-10. Line labels = multilayer. X axis = multiplier. Y-axis = product. Extending this pattern to other quadrants gives the reason why a negative number of times gives a positive number. Also note how multiplication by zero reduces dimensionality, as does multiplication by a single matrix, where the determinant is 0. In this process, the information is lost and cannot be recovered. For real and complex numbers, which includes, for example, natural numbers, integers, and fractions, multiplication has some properties: Alternate property The multiplication order of two numbers does not matter: x - y = y - x . {\displaystyle x\cdot y=y\cdot x.} Associative properties Expressions that include multiplication or addition only are immutable to the order of operations: (x - y) - z = x , (y - z) {\displaystyle (x\cdot y)\cdot z=x\cdot (y\cdot z)} Distribution properties Stores in relation to multiplication over addition. This identity is of paramount importance for simplifying algebraic expressions: x - (y + z) = x , y + x - z {\displaystyle x\cdot (y+z)=x\cdot y+x\cdot z} Multiplier identity element is 1; everything multiplied by 1 is in itself. This function 1 is known as an identity property: x - 1 = x {\displaystyle x\cdot 1=x} Property 0 Any number multiplied by 0 is 0. This is called equal to the zero multiplication property: x - 0 = 0 {\displaystyle x\cdot 0=0} Negation −1 times any number is equal to the inverse of the addition of this number. (− 1) - x = (− x) {\displaystyle (-1)\cdot x=(-x)} where (− x) + x = 0 {\displaystyle (-x)+x=0} –1 times –1 to 1. (− 1) (− 1) = 1 {\displaystyle (-1)\cdot (-1)=1} Inverse Any number x, except 0, has a multiplication of inverse, 1 x {\displaystyle {\frac {1}{x}}} , such that x - (1 x) = 1 {\displaystyle x\cdot \left({\frac {1}{x}}\right)=1} . Multiplying the behavior of a verb by a positive number preserves the order: For > 0 if b > c, then ab > ac. Multiplying by negative number reverses the order: For < 0, if b > c, then ab < ac. Complex numbers do not have an order. Other mathematical systems that contain a multiplication operation may not have all of these properties. For example, multiplication is not, in general, alternate for arrays and quarters. Axiom Main article: Axioms peano In the book Arithmetices principia, nova methodo exposita, Giuseppe Peano proposed axioms for arithmetic based on his axioms for natural numbers. [16] Peano arithmetic has two axioms to multiply: x × 0 = 0 {\displaystyle x\times 0=0} x × S (y) = (x × y) + x {\displaystyle x\times S(y)=(x\times y)+x} Here S(y) represents y's successor, or the natural number that follows y. Various properties such as associatology can be proven with these and other axioms of Peano arithmetic, including induction. For example, S(0), marked by 1, is the multiplication identity because x × 1 = x × S (0) = (x × 0) + x = 0 + x = x {\displaystyle x\times 1=x\times S(0)=(x\times 0)+x=0+x=x} Axioms for integers usually define them as equivalence classes of ordered natural number pairs. The model is based on the treatment (x,y) as the equivalent of x − y when x and y are treated as integers. Therefore, both (0.1) and (1.2) are equivalent to −1. The multiplication axiom for an integer defined in this way is (x p , x m) × (y p , y m) = (x p × y p + x m × y m , x p × y m + x m × y p) {\displaystyle (x_{p},\,x_{m})\times (y_{p},\,x_{m})\times y_{m})=(x_{p}\times y_{p}+x_{m}\times y_{m},\;x_{p}\times y_{m}+x_{m}\times y_{p})} Rule , according to which × −1 = 1 can then be inferred from (0 , 1) × (0 0 1) = (0 × 0 + 1 × 1 , 0 × 1 + 1 × 0) = (1 , 0) {\displaystyle (0.1)\times (0.0 ,0 1)=(0\times 0+1\times 1,\,0\times 1+1\times 0)=(1,0)} Multiplication is extended in a similar way to rational numbers and then to real numbers. Multiplication with the product set theory of non-integers can be defined by the assembly theory using cardinal numbers or Peano axioms. See below how to extend this to multiply any integer, and then any rational number. The product of real numbers is defined in terms of products of rational numbers, see construction of real numbers. Multiplication in group theory There are many sets that, as part of a multiplication operation, meet the axioms that define the structure of a group. These axioms are closing, associativity, and enabling element identity and inverse. A simple example is a set of non-zero numbers. Here we have an identity of 1, as opposed to groups within the add-in, where the identity is usually 0. Note that with justification, we need to exclude zero, because under multiplication, there is no inverse: there is no rational number that can be multiplied by zero to bring to 1. In this example, we have an abel group, but that's not always the case. To see this, consider a set of inverted square matrices of a given dimension over a given field. Here it is simple to verify the closure, associacation, and inclusion of identity (identity matrix) and inverse. However, the multiplication of the matrix is not comnating, which shows that this group is not Ababian. Another fact that is worth noting is that integers under multiplication is not a group, even if we exclude zero. This is easily seen by the inverse of all elements other than 1 and −1. Multiplication in group theory is usually quoted either by a period or by a schedule (omission of the feature symbol between elements). Thus, the multiplication of element a by element b can be seen as {\displaystyle \cdot } b or ab. For a group by indicating a set and an operation, a period is used. For example, our first example might be indicated by (Q / { 0 } ,) {\displaystyle \left(\mathbb {Q} /\{0\},\,\cdot \right)} . Multiplication of different types of numbers Numbers can count (3 apples), order (third apple) or measure (3.5 feet high); in the history of mathematics progresses from counting on the fingers to modeling quantum mechanics, multiplication has been generalized to more complex and abstract types of numbers, and to things that are not numbers (such as matrices) or do not look like numbers (such as quarters). Integers N × M {\displaystyle N\times M} is the sum of N copies of M, while N and M are positive integers. This gives the number of things in the array N wide and M high. Generalization of negative numbers can be performed by N × (M) = (− N) × M = − (N × M) {\displaystyle N\times (-M)=(-N)\times M=-(N\times M)} and (− N) × (− M) = N × M {\displaystyle (-N)\times (-M)=N\times M} The same rules apply to rational and real numbers. Rational numbers Generalization to fraction A B × C D {\displaystyle {\frac {A}{B}}\times {\frac {C}{D}}} multiplies counters and denominators, respectively: A B × C D = (A × C) (B × D) {\displaystyle {\frac {A}{B}}\times {\frac {C}{D}={\frac {(A\times C)}{(B\times D)}}} . This gives the rectangle area A B {\displaystyle {\frac {A}{B}}} high and C D {\displaystyle {\frac {C}{D}}} wide and is the same as the number of things in the array when rational numbers are whole numbers. Actual numbers Actual numbers and their products can be defined in terms of a sequence of rational numbers. Complex numbers Given complex numbers with 1 {\displaystyle z_{1}} and 2 {\displaystyle z_{2}} as ordered pairs of real numbers (a 1 , b 1) {\displaystyle (a_{1},b_{1})} and (a 2 , b 2) {\displaystyle (a_{2},b_{2})} , product with 1 × of 2 {\displaystyle z_{1}\times z_{2}} is (1 × and 2 − b 1 × b 2 , and 1 × b 2 + a 2 × b 1) {\displaystyle (a_{1}\times a_{2}-b_{1}\times b_{2}.a_{1}\times b_{2}+a_{2}\times b_{1})} . This is the same as in reality, 1 × 2 {\displaystyle a_{1}\times a_{2}} when the imaginary parts b 1 {\displaystyle b_{1}} and b 2 {\displaystyle b_{2}} are null. In an equivalent way, − 1 {\displaystyle {\sqrt {-1}}} as and {\displaystyle i} , we have 1 × of 2 = (a 1 + b 1 i) (a 2 + b 2 i) = (a 1 × a 2) + (a 1 × b 2 i) + (b 1 × a 2 i) + (b 1 × b 2 and 2) = (a 1 a 2 − b 1 b 2) + (a 1 b 2 + b 1 a 2) and . {\displaystyle z_{1}\times z_{2}=(a_{1}+b_{1}i)(a_{2}+b_{2}i)=(a_{1}\times a_{2})+(a_{1}\times b_{2} (b_{1}-a_{2}i)+(b_{1}\times b_{2}i^{2})=(a_{1}a_{2}-b_{1}b_{2})+(a_{1}b_{2}+b_{1}a_{2})i.} Further generalizations see Multiplication in Group Theory, above, and Multiplication Group, which for example involves matrix multiplication. Very general and abstract, the concept of multiplication is as a multiplicatively marked (second) binary operation in a ring. An example of a ring that is not one of the above number systems is a polynomian ring (you can add and multiply polynomians, but polynomians are not numbers in any ordinary sense.) Splitting Frequently, x y {\displaystyle {\frac {x}{y}}} is the same as multiplication by inverse, x (1 y) {\displaystyle x\left({\frac {1}{y}}\right)} . Multiplying certain types of numbers can have the appropriate division, without the opposite; in an integral domain, x may not have the inverse of 1 x {\displaystyle {\frac {1}{x}}} but you can define x y {\displaystyle {\frac {x}{y}}}}} There are inverses in the split ring, but x y {\displaystyle {\frac {x}{y}}} can be ambiguous in non-communicative rings from x (y) {\displaystyle x\left({\frac {1}{y}}\right)} need not be the same as (1 y) x {\displaystyle \left({\frac {1}{y}\right)x} . Exponent Main Article: Exponent When multiplication is repeated, the resulting operation is known as an exponent. For example, the product of three factors two (2×2×2) is two raised to the third power, and is marked by 23, two with a top index of three. In this example, number two is the base and three is the exponent. In general, the exponent (or superscript) indicates how many times the base appears in the expression so that the expression n = × × ⋯ × ⏟ n {\displaystyle a^{n}=\underbrace {a\times a\times \cdots \times a} _{n}} indicates that n copies of base a are to be multiplied together. This notation can be used when multiplication is known as assocjative power supply. See also Dimensional Analysis Of Caratsuba Algorithm Multiplication Algorithm, for Large Numbers Multiplication Toom-Cook, for Very Large Numbers Schönhage-Strassen Algorithm, for huge numbers Multiplication binary table, as computers multiply booth's multiplication algorithm Floating point fused multiply-add Multiply-accumulate Wallace tree Multiplicative inverse, mutual summary Genaille-Lucas rulers Napier's bones Peasant multiplication product (mathematics), for generalizations Slide rule Notes ^ a b c Devlin, Keith (January 2011). What exactly is multiplication?. Mathematical Association of America. 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