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Chapter 1 : Addition â€“ Basic Addition Facts / FREE Printable Worksheets â€“ Worksheetfun

Arithmetic (from the Greek á¼€Ï•Î¹Î¸Î¼ÏŒÏ, arithmos, "number" and Ï„Î¹ÎºÎ®, tikÃ© [tÃ©chne], "art") is a branch of mathematics that consists of the study of numbers, especially the properties of the traditional operations on themâ€”addition, subtraction, multiplication and division.

Method of complements Subtraction is the inverse operation to addition. Subtraction finds the difference between two numbers, the minuend minus the subtrahend: Resorting to the previously established addition, this is to say that the difference is the number that, when added to the subtrahend, results in the minuend: For positive arguments M and S holds: If the minuend is larger than the subtrahend, the difference D is positive. If the minuend is smaller than the subtrahend, the difference D is negative. Subtraction is neither commutative nor associative. The immediate price of discarding the binary operation of subtraction is the introduction of the trivial unary operation , delivering the additive inverse for any given number, and losing the immediate access to the notion of difference , which is potentially misleading, anyhow, when negative arguments are involved. For any representation of numbers there are methods for calculating results, some of which are particularly advantageous in exploiting procedures, existing for one operation, by small alterations also for others. The trade-off is the halving of the number range for a fixed word length. A formerly wide spread method to achieve a correct change amount, knowing the due and given amounts, is the counting up method, which does not explicitly generate the value of the difference. Suppose an amount P is given in order to pay the required amount Q, with P greater than Q. Multiplication Multiplication is the second basic operation of arithmetic. Multiplication also combines two numbers into a single number, the product. The two original numbers are called the multiplier and the multiplicand, mostly both are simply called factors. Multiplication may be viewed as a scaling operation. Another view on multiplication of integer numbers, extendable to rationals, but not very accessible for real numbers, is by considering it as repeated addition. There are different opinions on the advantageousness of these paradigmata in math education. Multiplication is commutative and associative; further it is distributive over addition and subtraction. One says, 0 is not contained in the multiplicative group of the numbers. When a or b are expressions not written simply with digits, it is also written by simple juxtaposition: In computer programming languages and software packages in which one can only use characters normally found on a keyboard, it is often written with an asterisk: Algorithms implementing the operation of multiplication for various representations of numbers are by far more costly and laborious than those for addition. Those accessible for manual computation either rely on breaking down the factors to single place values and apply repeated addition, or employ tables or slide rules , thereby mapping the multiplication to addition and back. These methods are outdated and replaced by mobile devices. Computers utilize diverse sophisticated and highly optimized algorithms to implement multiplication and division for the various number formats supported in their system. Division mathematics Division is essentially the inverse operation to multiplication. Division finds the quotient of two numbers, the dividend divided by the divisor. The quotient multiplied by the divisor always yields the dividend. Division is neither commutative nor associative. So as explained for subtraction , in modern algebra the construction of the division is discarded in favor of constructing the inverse elements with respect to multiplication, as introduced there. Modern methods for four fundamental operations addition, subtraction, multiplication and division were first devised by Brahmagupta of India. Positional notation also known as "place-value notation" refers to the representation or encoding of numbers using the same symbol for the different orders of magnitude e. Algorism comprises all of the rules for performing arithmetic computations using this type of written numeral. For example, addition produces the sum of two arbitrary numbers. The result is calculated by the repeated addition of single digits from each number that occupies the same position, proceeding from right to left. An addition table with ten rows and ten columns displays all possible values for each sum. The rightmost digit is the value for the current position, and the result for the subsequent addition of the digits to the left increases by the value of the second leftmost digit, which is always one. The process for multiplying two arbitrary numbers is similar to the process for addition. A multiplication table with ten rows and ten columns lists the results for

each pair of digits. Additional steps define the final result. Similar techniques exist for subtraction and division. The creation of a correct process for multiplication relies on the relationship between values of adjacent digits. The value for any single digit in a numeral depends on its position. Also, each position to the left represents a value ten times larger than the position to the right. In mathematical terminology, this characteristic is defined as closure , and the previous list is described as closed under multiplication. It is the basis for correctly finding the results of multiplication using the previous technique. This outcome is one example of the uses of number theory. Compound unit arithmetic[edit] Compound [9] unit arithmetic is the application of arithmetic operations to mixed radix quantities such as feet and inches, gallons and pints, pounds shillings and pence, and so on. Prior to the use of decimal-based systems of money and units of measure, the use of compound unit arithmetic formed a significant part of commerce and industry. Basic arithmetic operations[edit] The techniques used for compound unit arithmetic were developed over many centuries and are well-documented in many textbooks in many different languages. Reduction where a compound quantity is reduced to a single quantity, for example conversion of a distance expressed in yards, feet and inches to one expressed in inches. Knowledge of the relationship between the various units of measure, their multiples and their submultiples forms an essential part of compound unit arithmetic. Principles of compound unit arithmetic[edit] There are two basic approaches to compound unit arithmetic: Reductionâ€”expansion method where all the compound unit variables are reduced to single unit variables, the calculation performed and the result expanded back to compound units. This approach is suited for automated calculations. A typical example is the handling of time by Microsoft Excel where all time intervals are processed internally as days and decimal fractions of a day. On-going normalization method in which each unit is treated separately and the problem is continuously normalized as the solution develops. This approach, which is widely described in classical texts, is best suited for manual calculations. An example of the ongoing normalization method as applied to addition is shown below. The numbers below the "answer line" are intermediate results. The total in the pence column is This operation is repeated using the values in the shillings column, with the additional step of adding the value that was carried forward from the pennies column. The pound column is then processed, but as pounds are the largest unit that is being considered, no values are carried forward from the pounds column. For the sake of simplicity, the example chosen did not have farthings. Operations in practice[edit] A scale calibrated in imperial units with an associated cost display. During the 19th and 20th centuries various aids were developed to aid the manipulation of compound units, particularly in commercial applications. Number theory Until the 19th century, number theory was a synonym of "arithmetic". It appeared that most of these problems, although very elementary to state, are very difficult and may not be solved without very deep mathematics involving concepts and methods from many other branches of mathematics. This led to new branches of number theory such as analytic number theory , algebraic number theory , Diophantine geometry and arithmetic algebraic geometry. Arithmetic in education[edit] Primary education in mathematics often places a strong focus on algorithms for the arithmetic of natural numbers , integers , fractions , and decimals using the decimal place-value system. This study is sometimes known as algorism. The difficulty and unmotivated appearance of these algorithms has long led educators to question this curriculum, advocating the early teaching of more central and intuitive mathematical ideas. One notable movement in this direction was the New Math of the s and s, which attempted to teach arithmetic in the spirit of axiomatic development from set theory, an echo of the prevailing trend in higher mathematics.

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Arithmetic operators take numerical values (either literals or variables) as their operands and return a single numerical value. The standard arithmetic operators are addition (+), subtraction (-), multiplication (*), and division (/). The source for this interactive example is stored in a GitHub.

Chapter 8 : Session 1: Basic Arithmetic

In mathematics and computer programming, the order of operations (or operator precedence) is a collection of rules that reflect conventions about which procedures to perform first in order to evaluate a given mathematical expression.

Chapter 9 : Basic mathematics

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