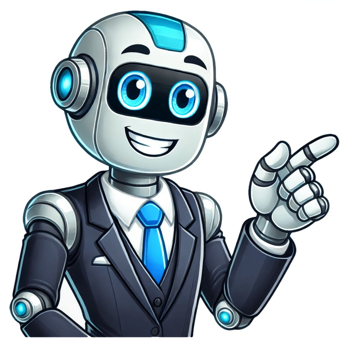

This operation (or function) rounds a value downwards to the nearest integer even if it is already negative. The floor function returns the remainder with the same sign as the divisor. This is the method used in our calculator. See how it works by examples: floor(2.1); // returns number 2 floor(2.7); // returns number 2 floor(-5.2); // returns number -6 floor(-5.7); // returns number -6 Some hints: a mod 1 is always 0; a mod 0 is undefined; Divisor (b) must be positive. This function is used in mathematics, where the result of the modulo operation is the remainder of the Euclidean division. The first result in our calculator uses, as stated above, the function floor() to calculate modulo as reproduced below: a mod b = a - b × floor(a/b) To understand how this operation works, we recommend reading What is modular arithmetic? from Khan Academy. In computers and calculators due to the various ways of storing and representing numbers the definition of the modulo operation depends on the programming language or the hardware it is running. For example, in PHP $a % $b means 'a' modulo 'b'. In Javascript, it is written as a % b. This symbol '%', in both languages, is called modulo operator. It simply returns the remainder of 'a' divided by 'b'. That explains the differences found in the calculator when 'a' (dividend) is negative and b isn't equal to 1. It is because a mod b isn't simply the remainder as returned by the operator '%'. See some examples: Operation a mod b $a % $b 5 mod 3 2 2 3 mod 1 0 0 -5 mod 3 1 -2 -3 mod 5 2 -3 15 mod 12 3 -3 29 mod 12 5 5 -4 mod 12 8 -4 -13 mod 6 5 -1 There are some other definitions in math and other implementations in computer science according to the programming language and the computer hardware. Please see Modulo operation from Wikipedia. 6 mod 222 mod 2024 mod 1322 mod 1210 mod 1424 mod 16 While every effort is made to ensure the accuracy of the information provided on this website, neither this website nor its authors are responsible for any errors or omissions. Therefore, the contents of this site are not suitable for any use involving risk to health, finances or property. Here we will explain what 3 mod 5 means and show how to calculate it. 3 mod 5 is short for 3 modulo 5 and it can also be called 3 modulus 5. Modulo is the operation of finding the Remainder when you divide two numbers. Therefore, when you ask "What is 3 mod 5?" you are asking "What is the Remainder when you divide 3 by 5?". We will show you two methods of finding 3 mod 5 (3 modulo 5). To differentiate our methods, we will call them the "Modulo Method" and the "Modulus Method". Before we continue, we remind you of what the different parts of a division problem are called so you can follow along: Dividend / Divisor = Quotient and in this case 3 is the Dividend, 5 is the Divisor, and the answer is called the Quotient. Furthermore, the Quotient x.y has two parts: x to the left of the decimal point is the Whole part, and y to the right of the decimal point is the Fractional part. Modulo Method To find 3 mod 5 using the Modulo Method, we first divide the Dividend (3) by the Divisor (5). Second, we multiply the Whole part of the Quotient in the previous step by the Divisor (5). Then finally, we subtract the answer in the second step from the Dividend (3) to get the answer. Here is the math to illustrate how to get 3 mod 5 using our Modulo Method: 3 ÷ 5 = 0.6 0 × 5 = 0 3 - 0 = 3 Thus, the answer to "What is 3 mod 5?" is 3. Modulus Method To find 3 mod 5 using the Modulus Method, we first find the highest multiple of the Divisor (5) that is equal to or less than the Dividend (3). Then, we subtract the highest Divisor multiple from the Dividend to get the answer to 3 modulus 5 (3 mod 5): Multiples of 5 are 0, 5, 10, 15, etc. and the highest multiple of 5 equal to or less than 3 is 0. Therefore, to get the answer: 3 - 0 = 3 Thus, once again, the answer to "What is 3 mod 5?" is 3. Modulo Calculator Do you have another "mod" problem you need solved? If so, please enter it here. Modular arithmetic, also known as clock arithmetic, deals with finding the remainder when one number is divided by another number. It involves taking the modulus (in short, 'mod') of the number used for division. If 'A' and 'B' are two integers such that 'A' is divided by 'B,' then: ${\dfrac{A}{B}=Q,remainderR}$ Here, Dividend = A Divisor = B Quotient = Q, and Remainder = R In modular arithmetic, it is written as A mod B = R, read as 'A modulo B equals R' where 'B' is referred to as modulus. This means if we divide 'A' by 'B' the remainder is 'R.' For example, ${\dfrac{14}{3}=4,remainder2}$ ⇒ 14 mod 3 = 2, which means if 14 is divided by 3, the remainder is 2. The concept of modular arithmetic can be best explained using the face of a clock. It has many applications in fields like cryptography, computer science, and number theory, and it is often used to detect errors in identification numbers. Now, let us visualize the modulo operator with a clock. To find the result of 14 mod 3 (A mod B), we will follow the following steps: Step 1: Constructing the clock for size 'B' First, we write 0 at the top of the clock and continue clockwise by writing 1, 2, … up to one less than the modulus. Here, 14 mod 3, the modulus is 3. Thus, 12 is replaced by a 0, then continuing 1 and 2 (= 3 – 1) in the clockwise direction of the circle, which is for the modulus of 3. Step 2: Starting at 0 and moving around the clock for 'A' steps Here, we start from 0, increase the number by 1 in each step, and divide them by 3. This continues until the number reaches one less than the number we are dividing by. After that, the sequence repeats. On dividing by 3, we get ${\dfrac{0}{3}=0,remainder0}$ ${\dfrac{1}{3}=0,remainder1}$ ${\dfrac{2}{3}=0,remainder2}$ ${\dfrac{3}{3}=1,remainder0}$ ${\dfrac{4}{3}=1,remainder1}$ ${\dfrac{5}{3}=1,remainder2}$ ${\dfrac{6}{3}=2,remainder0}$ ${\dfrac{7}{3}=2,remainder1}$ ${\dfrac{8}{3}=2,remainder2}$ ${\dfrac{9}{3}=3,remainder0}$ ${\dfrac{10}{3}=3,remainder1}$ ${\dfrac{11}{3}=3,remainder2}$ ${\dfrac{12}{3}=4,remainder0}$ ${\dfrac{13}{3}=4,remainder1}$ ${\dfrac{14}{3}=4,remainder2}$ Step 3: Finding the Solution Thus, we get the solution 2. Two integers, 'A' and 'B,' are considered congruent under modulo 'n' if they yield the same remainder when divided by the positive integer 'n.' For example, 17 and 32 are congruent to modulo 3, which implies 17 ≡ 32 (mod 3). This means the remainder of dividing '17 by 3' and '32 by 3' are 2. In general, two integers, 'A' and 'B,' are congruent to modulo 'n' when (A – B) is a multiple of 'n,' which means A ≡ B when ${\dfrac{A-B}{n}}$ is an integer. However, A ≢ B (mod n) means that 'A' and 'B' are not congruent to modulo 'n.' Find the value of 516 in modulo 7Solution:As we know, 516 ÷ 7 = 73, remainder 5Thus, 516 ≡ 5 (mod 7), which means 5 is the value of 516 in modulo 7 While solving modular arithmetic problems, we directly operate on the remainder without tedious computations, following the given rules or properties. If A + B = C, then A (mod n) + B (mod n) ≡ C (mod n) If A ≡ B (mod n), then A + k ≡ B + k (mod n) for any integer 'k' If A ≡ B (mod n) and C ≡ D (mod n), then A + C ≡ B + D (mod n) If A ≡ B (mod n), then -A ≡ -B (mod n) Find the value of (32 + 47) in modulo 6Solution:As we know, if A + B = C, then A (mod n) + B (mod n) ≡ C (mod n)Here, (32 + 47) = 79 Now, using the properties of addition, we get 32 (mod 6) + 47 (mod 6) ≡ 79 (mod 6) ≡ 1 (mod 6)Thus, the value of (32 + 47) in modulo 6 is 1 The same rules for modular addition can also be applied to modular subtraction. Find the remainder when the difference between 458 and 192 is divided by 5.Solution:Here, 458 = 5(91) + 3, the remainder is 3 when 456 is divided by 5192 = 5(38) + 2, the remainder is 2 when 192 is divided by 5Now, 458 ≡ 3 (mod 5) and 192 ≡ 2 (mod 5), which implies 458 – 192 ≡ 3 – 2 ≡ 1 (mod 5).Thus, the remainder is 1 when the difference of 458 and 192 is divided by 5 If A · B = C, then A (mod n) · B (mod n) ≡ C (mod n) If A ≡ B (mod n), then kA ≡ kB (mod n) for any integer 'k' If A ≡ B (mod n) and C ≡ D (mod n), then AC ≡ BD (mod n) Solve: (15 × 81) (mod 12)Solution:Here, the value of (15 × 81) (mod 12) is expressed as 15 (mod 12) × 81 (mod 12)Since 15 ≡ 3 (mod 12) and 81 ≡ 9 (mod 12) ⇒ (15 × 81) ≡ (3 × 9) ≡ 27 ≡ 3 (mod 12) We note that modular division is different from addition, subtraction, and multiplication. This means ${\dfrac{A}{B}\left(mod \ n\right)}$ does not equal to ${\left(\dfrac{A\left(mod \ n\right) }{B\left(mod \ n\right) }\right) \left(mod \ n\right)}$ Here, we calculate ${\dfrac{A}{B}\left(mod \ n\right)}$ using the following formula: ${\dfrac{A}{B}\left(mod \ n\right)}$ = (A × (inverse of B, if it exists)) (mod n) However, if we add the condition that k and n are coprime to each other, then the division becomes well-defined. Mathematically, if gcd(k, n) = 1 and kA ≡ kB (mod n), then A ≡ B (mod n), which means if k(A – B) is a multiple of 'n' and gcd(k, n) = 1, then 'n' divides (A – B) or A ≡ B (mod n) The modular inverse of 'A' in modulo 'n' exists if only if 'A' and 'n' are relatively prime. Thus, if gcd(A, n) = 1 and (A · B) (mod n) = 1 ⇒ (A · B) ≡ 1 (mod n), then 'B' is the modular inverse of 'A.' For example, A = 7, n = 9, and (7 × 4) ≡ 1 (mod 9), thus, 4 is the modular inverse of 7. If A ≡ B (mod n), then Ak ≡ Bk (mod n) for any positive integer 'k' Let us find the value of 221 (mod 5) Since 20 ≡ 1 (mod 5) 21 ≡ 2 (mod 5) 22 ≡ 4 (mod 5) 23 ≡ 3 (mod 5) 24 ≡ 1 (mod 5) We observe that the result repeats after every multiple of 4. Thus, 221 ≡ (24)5 × 21 ≡ 1 × 2 ≡ 2 (mod 5), means 221 in modulo 5 is 2. In the above example, we do not need to find the exact value of 221, which is very large. In such cases, we can find the last digit of any number raised to a big exponent. Determine the last digit of the remainder when 1339 is divided by 4.Solution:Since the last digit of 130 = 1, the last digit of 131 = 3,the last digit of 132 = 9,the last digit of 133 = 7,and the last digit of 134 = 1. The cycle repeats as 1, 3, 9, 7, and again it is 1Here, the last digit of 1339 = (134)9 · 133 = (1)9 · 7 = 7Thus, the last digit of 1339 is 7 ⇒ 1339 ≡ 3 (mod 4) For calculating 1258 in modulo 4 (as 'A' in modulo 'n') using a standard calculator, we follow the following steps: Step 1: Dividing 'A' by 'n' 1258 ÷ 4 = 314.5 Step 2: Subtracting the whole Part of the Resulting Quantity 314.5 – 314 = 0.5 Step 3: Multiplying the Difference by 'n' to Obtain the Modulus 0.5 × 4 = 2Thus, we get 1258 ≡ 2 (mod 4) Last modified on May 24th, 2024 You may see modulo operations on numbers expressed as either of the following a modulo n a mod n (abbreviated version) Example Math Problems 17 modulo 3 17 - 3 = 14 14 - 3 = 11 11 - 3 = 8 8 - 3 = 5 5 - 3 = 2 20 mod 5 20 - 5 = 15 15 - 5 = 10 10 - 5 = 5 5 - 5 = 0 Modulo: Definition, How it Works, and Real-Life Uses - Guide Authored by Corin B. Arenas, published on October 24, 2019 Most people haven't heard of modular arithmetic or mod outside of math class. However, if you've ever estimated lunch for 10 people, and found that there's a lot of food leftover, you're actually dealing with a mod problem. People use modular arithmetic all the time, especially with anything involving remainders, time and calendar schedules. In this section, you'll learn about modulo, its basic operation, and its uses in real life. What is Modulo? Modular arithmetic, sometimes called clock arithmetic, is a calculation that involves a number that resets itself to zero each time a whole number greater than 1, which is the mod, is reached. An example of this is the 24-hour digital clock, which resets itself to 0 at midnight. In mathematics, the modulo is the remainder or the number that's left after a number is divided by another value. Modulo is also referred to as 'mod.' The standard format for mod is: a mod n Where a is the value that is divided by n. For example, you're calculating 15 mod 4. When you divide 15 by 4, there's a remainder.15 / 4 = 3.75 Instead of its decimal form (0.75), when you use the mod function in a calculator, the remainder is a whole number. For this example, 15 / 4 = remainder 3, which is also 15 = (4 * 3) + 3. Here's how to calculate it manually: 15 mod 4 15 – 4 = 1111 – 4 = 77 – 4 = 3 Calculating Mod with a Negative Number One might presume the mod function generates the same values as positive numbers when one number is negative. This is actually not the case. For instance, if you have 340 mod 60, the remainder is 40.But if you have -340 mod 60, the remainder is 20. Why does this happen? Mathforum.org explains, with a positive number like 340, the multiple subtracted is less than the absolute value, which results in 40. 340 mod 60340 – 60 = 280280 – 60 = 220220 – 60 = 160160 – 60 = 100100 – 60 = 40 But with -340, we subtract a number with a greater absolute value, so the mod function generates a positive value. The resulting remainder is also smaller compared to when both numbers are positive. Here's how to solve mod with a negative number:a mod n is a/n = r (remainder) Therefore, a mod n = a – r * n Take note: When we input a/b in a calculator, we take the decimal part of the generated value, and round it up to the next integer. Let's do it with the example below: -340 mod 60-340/60 = 5.6, when we take the decimal part, it becomes the integer -6= -340 -(-6) * 60= -340 -(-360)= 20 To help you visualize, the number line below shows the difference in value. Who Created Modular Arithmetic? According to Britannica, the concept of modular arithmetic has been used by ancient civilizations such as the Indians and Chinese. An example is the Chinese book Master Sun's Mathematical Manual, which dates back from 300 AD. Moreover, modular arithmetic was used to solve astronomical and seasonal calculations which were problems associated with natural and man-made cycles. Carl Friedrich Gauss and the Number Theory In Western mathematics, German mathematician and physicist Carl Friedrich Gauss did the first systematic study of modular arithmetic. Gauss is regarded as one of the most influential figures in modern mathematics. In his early 20s in 1801, he published Disquisitiones Arithmeticae, which laid the foundation for today's number theory and showed the first proof of the law of quadratic reciprocity. In the number theory, scholars analyze the properties of natural numbers, which are whole numbers like -1, -2, 0, 1, 2, and so on. Their objective is to discover unexpected mathematical patterns and interactions between natural numbers. Britannica notes that in modular arithmetic, where mod is N, all the numbers (0, 1, 2, …, N − 1,) are known as residues modulo N. The residues are added by finding the arithmetic sum of the numbers, and the mod is subtracted from the sum as many times as possible. This diminishes the sum to a number M, which is between 0 and N – 1. In his book, Gauss included a notation with the symbol ≡, which is read as "is congruent to." Instead of the usual = symbol, the three horizontal line segments both signify equality and definition. For instance, if we add the sum of 2, 4, 3 and 7, the sum is congruent to 6 (mod 10). That's 16 ≡ (mod 10). This means 16 divided by 10 leaves a remainder of 6. Likewise, 16 – 10 = 6. Another example, 13 ≡ 1 (mod 12). This means 13 divided by 12 leaves a remainder of 1. Likewise, 13 – 12 = 1. What are Real-World Uses for Mod? For practical applications, mod is especially useful for dealing with time. Since we have 24 hours in a day, it makes sense to refer to time in a 24-hour fashion. This is the principle behind the military time system, beginning at midnight with 0000 hours, and ending the hour at 11PM with 2300 hours. Instead of saying 9 o'clock PM, they say 2100 hours. The military uses this to coordinate with bases and other personnel located in different time zones. Moreover, all pilots (commercial or otherwise) use the 24-hour clock to avoid confusion while traveling between time zones. To set a standard, pilots and the military use the Greenwich Mean Time (GMT) which they also call Zulu time (Z). For instance, when pilots report that a plane will reach a base at 2100Z, it means it will arrive at 9PM GMT. How is this connected with modulo? For people staying in one time zone, it's more important to tell time by separating night and day. This is why the 12-hour standard time uses modulo. Instead of saying 1600 hours, we just say 4 o'clock. The 12-hour standard time uses mod 12 so that 1600 hours becomes 4 o'clock. When we make appointments, it's generally understood people mean 4 in the afternoon. Unless specified otherwise, a 4am meeting is absurd, unless you work at night and have online meetings with clients from other time zones. Organizing Books, Bank Info, and Housing Loan Rates Mod is useful for organizing large information. Books are tracked using modular arithmetic to calculate checksums for international standard book numbers (ISBN). In 2007, a 13-digit ISBN number system (which was previously 10) was introduced to help manufacturers identify a large volume of books. The same principle is also used by banks to identify errors on international bank account numbers (IBAN) when they track transactions from other countries. When it comes to housing loans, mod is used to reset calculations for a new period. For instance, a 5/6 adjustable rate mortgage (ARM) resets its interest rates periodically every 6 months. Mod is used to adjust the rates accordingly. Cryptography and Computer-Generated Art Modular arithmetic has other applications in the field of cryptography, art and graphics design. For many years, artists have been using mathematical shapes based on formulas to create designs. Today, the same concept is applied to computer graphics, as well as sculptures and modern paintings. In cryptography, codes are written to protect secret data. Cryptographers use mod in the Diffie-Hellman Key Exchange in setting up SSL connections to encrypt web traffic. Encryption is important because it allows users to safeguard information. That's why your personal emails, credit card number, and other personal details should be encrypted whenever you send information on the internet. The Bottom Line Mod is a mathematical function that allows us to measure the remainder in a sum. We use this fundamental concept whenever we tell time. The concept of modular arithmetic has been used by ancient Chinese and Indians for centuries. But it was introduced into Western mathematics by German scientist Carl Friedrich Gauss, who also developed the basis for the number theory. Real-world uses for mod include organizing ISBN and bank information, resetting ARM rates, computer graphics design, and cryptography which helps protect private data. About the Author Corin is an ardent researcher and writer of financial topics—studying economic trends, how they affect populations, as well as how to help consumers make wiser financial decisions. Her other feature articles can be read on Inquirer.net and Manileno.com. She holds a Master's degree in Creative Writing from the University of the Philippines, one of the top academic institutions in the world, and a Bachelor's in Communication Arts from Miriam College. Calculate a mod b which, for positive numbers, is the remainder of a divided by b in a division problem. The modulo operation finds the remainder, so if you were dividing a by b and there was a remainder of n, you would say a mod b = n. How to Do a Modulo Calculation The modulo operation finds the remainder of a divided by b. To do this by hand just divide two numbers and note the remainder. If you needed to find 27 mod 6, divide 27 by 6. 27 mod 6 = ? 27 ÷ 6 = 4 with a remainder of 3 27 mod 6 = 3 Example Modulo Calculation You need to write a piece of software that tells a user whether a number they input is a multiple of 4. You can use the modulo calculation to accomplish this. If a number is a multiple of 4, when you divide it by 4 the remainder will be 0. So you would create the logic to take an input and use the mod 4 operation on it. If the result is 0 the number is a multiple of 4 otherwise the number is not a multiple of 4. The logic for this part of your program would be: x is the number input by the user If x mod 4 = 0 then x is a multiple of 4 Else x is not a multiple of 4 If you did not use the mod operator you would have to do the math in your code. For example you would have to calculate "is 496 a multiple of 4?". You would divide 496 by 4, so 496 / 4 = 124 with no remainder. In terms of mod, 496 mod 4 = 0, so yes, 496 is a multiple of 4. Is 226 a multiple of 4? Divide 226 by 4, so 226 / 4 = 56 with a remainder of 2. 226 mod 4 = 2, so no, 226 is not a multiple of 4. In some calculators and computer programming languages a % b is the same as a mod b is the same as a modulo b where % or mod are used as the modulo operators. Example: 1 mod 2 1 mod 2 is a situation where the divisor, 2, is larger than the dividend, 1, so the remainder you get is equal to the dividend, 1. For 1 divided by 2, 2 goes into 1 zero times with a remainder of 1. So 1 mod 2 = 1. Similarly, 5 mod 10 = 5 since 10 divides into 5 zero times with 5 left over as the remainder. For positive numbers, whenever the divisor (modulus) is greater than the dividend, the remainder is the same as the dividend. Further Reading Explore modular arithmetic and modulo operations further including a mod b for negative numbers. Kahn Academy, What is Modular Arithmetic? Better Explained, Fun with Modular Arithmetic Wikipedia, Applications of Modular Arithmetic Mathworld, Congruence Kahn Academy, Congruence Modulo The Modulo calculator is a free online tool to calculate the Modulo(Dividend % Divisor). This geeks for geeks online Modulo calculator makes the calculation faster and it displays the calculation in a fraction of a second. It is an easy-to-use general-purpose calculator that makes it a versatile tool, suitable for a wide range of applications, from engineering to academics. It again helps students and working professionals solve various day-to-day problems. To calculate a mod b, which is for positive numbers, simply find the remainder of a divided by b in a division problem. This modulo operation helps to determine the remainder. For instance, if you were dividing a by b and there was a remainder of n, then the result of a mod b would be n. What Is Modulo?The modulo operation finds the remainder when the dividend 'a' is divided by the divisor 'b'.Mathematically, it is represented as: (a \mod b = r), where 'r' is the remainder.For example: - If you need to find (13 \mod 5), divide 13 by 5: (13 \div 5 = 2) with a remainder of 3. Therefore, (13 \mod 5 = 3). What does a % b represents:It is the remainder of a divided by b in a division problem. a % b = r, where r is the remainder when a is divided by b. How to Do a Modulo Calculation:The modulo operation finds the remainder of a divided by b. To do this by hand just divide two numbers and note the remainder. If you need to find 13 mod 5, divide 13 by 5. 13 mod 5 = ?13 ÷ 5 = 2 with a remainder of 313 mod 5 = 3Validate the remainder by using below equation:Quotient × Divisor + Remainder = Dividend Divide a by b to find the remainder.13 ÷ 5 = 2 R3, 2 is the dividend and 3 is the remainderConfirm the answer satisfies the equation:Quotient × Divisor + Remainder = Dividend2 × 5 + 3 = 13Why Use the Modulo Operation?Modulo has various applications, from computer science to engineering.It helps solve day-to-day problems for students and professionals.Whether you're calculating checksums, handling cyclic patterns, or optimizing algorithms, modulo plays a crucial role.ConclusionModulo calculator is a basic calculator, a free online tool prepared by GeekforGeeks that calculate the modulo. It is a fast and easy-to-use tool that helps students in solving various problems.