

A) Express 792 As The Product Of Its Prime Factors. Write The Prime Factors In Ascending Order.

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Understanding how to express a number as a product of its prime factors is a fundamental skill in mathematics, especially in areas like number theory, cryptography, and simplifying fractions. In this article, we will explore the process of prime factorization using the specific example of the number 792. We will demonstrate step-by-step how to break down 792 into its prime factors and write them in ascending order. Additionally, we will discuss the significance of prime factorization, methods to perform it efficiently, and real-world applications.

What Is Prime Factorization?

Prime factorization is the process of expressing a composite number as a product of prime numbers. Prime numbers are natural numbers greater than 1 that have no divisors other than 1 and themselves. Every composite number can be uniquely written as a product of prime numbers, which is known as its prime factorization, according to the Fundamental Theorem of Arithmetic.

For example:

- 12 can be expressed as $2 \times 2 \times 3$
- 60 can be expressed as $2 \times 2 \times 3 \times 5$

Expressing numbers in their prime factors simplifies many mathematical operations, such as finding the greatest common divisor (GCD), least common multiple (LCM), or simplifying fractions.

Step-by-Step Prime Factorization of 792

Let's now focus on the number 792 and determine its prime factors in ascending order.

Step 1: Check for divisibility by small prime numbers

The smallest prime numbers to test are 2, 3, 5, 7, 11, etc.

- Is 792 divisible by 2?
Yes, because 792 is even.
 $792 \div 2 = 396$

- Is 396 divisible by 2?
Yes, 396 is even.
 $396 \div 2 = 198$

- Is 198 divisible by 2?
Yes, 198 is even.
 $198 \div 2 = 99$

Now, 99 is not even, so move to the next prime number.

Step 2: Check divisibility by 3

- Is 99 divisible by 3?
Sum of digits = $9 + 9 = 18$, which is divisible by 3.
Yes, so $99 \div 3 = 33$

- Is 33 divisible by 3?
Sum of digits = $3 + 3 = 6$, divisible by 3.
Yes, $33 \div 3 = 11$

- Is 11 divisible by 3?
No, because $11 \div 3$ is not an integer.

Next, check divisibility by the next prime numbers.

Step 3: Check divisibility by 11

- 11 is a prime number, and $11 \div 11 = 1$.

Since we've reached 1 after dividing by 11, the factorization process concludes.

Complete Prime Factorization of 792

Now, gathering all the prime factors:

- From dividing by 2 repeatedly: 2, 2, 2
- From dividing by 3 repeatedly: 3, 3
- From dividing by 11: 11

Expressed as a product:

$$\backslash[792 = 2 \backslashtimes 2 \backslashtimes 2 \backslashtimes 3 \backslashtimes 3 \backslashtimes 11 \backslash]$$

To write the prime factors in ascending order:

$$\backslash[792 = 2^3 \backslashtimes 3^2 \backslashtimes 11 \backslash]$$

Understanding the Prime Factorization of 792

The prime factorization reveals the building blocks of 792. Each prime factor contributes to the composition of the number, and the exponents indicate how many times each prime appears in the factorization.

- 2 appears three times.
- 3 appears twice.
- 11 appears once.

Expressed succinctly:

$$\backslash[792 = 2^3 \backslashtimes 3^2 \backslashtimes 11 \backslash]$$

Significance and Applications of Prime Factorization

Prime factorization is not just an academic exercise; it has practical applications across various fields:

1. Simplifying Fractions

Prime factorization helps in reducing fractions to their simplest form by canceling common factors. For example, to simplify $\backslash(\backslashfrac{792}{924}\backslash)$, factor both numerator and denominator to identify common prime factors.

2. Finding the Greatest Common Divisor (GCD)

The GCD of two numbers is the largest prime factor they share. Knowing the prime factorizations allows quick computation.

Example:

Find GCD of 792 and 924.

- $792 = 2^3 \times 3^2 \times 11$
- $924 = 2^2 \times 3 \times 7 \times 11$

Common prime factors: $2^2, 3^1, 11$

$$\text{GCD: } 2^2 \times 3 \times 11 = 4 \times 3 \times 11 = 132$$

3. Calculating the Least Common Multiple (LCM)

The LCM can be found by taking the highest powers of each prime factor from both numbers.

Using the above:

- For 2: max power is 2^3 (from 792)
- For 3: max power is 3^2 (from 792)
- For 7: 7^1 (from 924)
- For 11: 11^1 (both)

$$\text{LCM: } 2^3 \times 3^2 \times 7 \times 11 = 8 \times 9 \times 7 \times 11 = 5544$$

Methods to Find Prime Factors

While the step-by-step division method is straightforward, especially for smaller numbers like 792, there are other techniques and tools to perform prime factorization efficiently:

1. Trial Division

Dividing the number successively by primes starting from 2, then moving to larger primes.

2. Using Prime Factorization Trees

Visual diagrams help break down composite numbers into prime factors systematically.

3. Prime Factorization Algorithms

Algorithms such as the Sieve of Eratosthenes or Pollard's Rho are used in computational contexts to factor large numbers efficiently.

4. Prime Factorization Tools and Calculators

Online tools can quickly find prime factors, especially for large numbers.

Conclusion

Expressing 792 as the product of its prime factors reveals its fundamental components and enhances understanding of its structure. The prime factorization of 792 is:

$$\boxed{792 = 2^3 \times 3^2 \times 11}$$

This process illustrates the importance of prime factorization in mathematics, providing the foundation for solving a variety of problems. Whether simplifying fractions, computing GCDs and LCMs, or exploring number theory, mastering prime factorization is an essential skill.

Remember, every composite number can be uniquely factored into primes, making prime factorization a cornerstone concept in mathematics. Practicing the process with different numbers will strengthen your ability to analyze and manipulate numerical data efficiently.

Frequently Asked Questions

What is the prime factorization of 792?

The prime factorization of 792 is $2^3 \times 3^2 \times 11$.

How do you express 792 as the product of its prime factors?

By dividing 792 repeatedly by prime numbers until only prime factors remain, resulting in $2 \times 2 \times 2 \times 3 \times 3 \times 11$.

What are the prime factors of 792 listed in ascending order?

The prime factors of 792 in ascending order are 2, 2, 2, 3, 3, and 11.

Why is prime factorization important for 792?

Prime factorization helps in understanding the number's properties, calculating its divisors, and simplifying fractions involving 792.

Can 792 be expressed as a product of prime factors without exponents?

Yes, 792 can be written as $2 \times 2 \times 2 \times 3 \times 3 \times 11$, explicitly showing each prime factor.

What steps are involved in prime factorizing 792?

First, divide 792 by the smallest prime (2), continue dividing the quotient by prime numbers (2, then 3, then 11) until the quotient is 1, then list all prime factors.

Is the prime factorization of 792 unique?

Yes, the prime factorization of any number, including 792, is unique according to the Fundamental Theorem of Arithmetic.

How can the prime factors of 792 help in finding its greatest common divisor (GCD) with other numbers?

By comparing prime factorizations, the GCD can be found by multiplying the lowest powers of common primes shared between the numbers.

Additional Resources

Express 792 as the Product of Its Prime Factors: Write the Prime Factors in Ascending Order

Understanding how to express a number as a product of its prime factors is a fundamental skill in number theory and mathematical problem-solving. Prime factorization not only helps in simplifying fractions, finding least common multiples (LCM), and greatest common divisors (GCD), but it also provides insight into the number's intrinsic properties. In this comprehensive review, we will explore how to express the number 792 as a product of its prime factors and organize those factors in ascending order. We will delve into the step-by-step process, discuss the significance of prime factorization, and examine related concepts to deepen your understanding.

What is Prime Factorization?

Prime factorization is the process of decomposing a composite number into a product of prime numbers. These prime numbers are the building blocks of the original number because every integer greater than 1 can be represented uniquely as a product of primes (Fundamental Theorem of Arithmetic).

Key Points:

- Prime numbers are numbers greater than 1 that have no divisors other than 1 and themselves.
- Every composite number can be expressed as a product of primes, and this expression is unique, apart from the order of the factors.

- Prime factorization is essential for simplifying fractions, finding GCD, LCM, and solving various algebraic problems.

Understanding the Number 792

Before diving into the factorization process, it's helpful to analyze the characteristics of 792:

Properties of 792:

- It is an even number (ends with 2), implying divisibility by 2.
- It can be broken down systematically into prime factors using divisibility rules.
- Recognizing divisible primes aids in efficient factorization.

Step-by-Step Prime Factorization of 792

The process involves dividing the number repeatedly by prime numbers starting from the smallest prime (2), then moving to larger primes as needed. Let's proceed systematically:

Step 1: Divide by 2

Since 792 is even, it is divisible by 2:

- $792 \div 2 = 396$

Now, 396 is also even:

- $396 \div 2 = 198$

Again:

- $198 \div 2 = 99$

At this point, 99 is no longer divisible by 2 because it's odd.

Prime factors so far:

- $2 \times 2 \times 2$ or 2^3

Remaining number: 99

Step 2: Divide 99 by 3

Check divisibility by 3:

- Sum of digits of 99: $9 + 9 = 18$, which is divisible by 3, so 99 is divisible by 3.

Perform the division:

- $99 \div 3 = 33$

Now, check 33:

- Sum of digits: $3 + 3 = 6$, divisible by 3, so 33 is divisible by 3:
- $33 \div 3 = 11$

Now, 11 is a prime number.

Prime factors identified so far:

- 2^3 (from earlier divisions)
- 3×3 (from dividing 99)
- 11 (remaining prime)

Step 3: Write the complete prime factorization

Combining all prime factors:

- $2^3 \times 3^2 \times 11$

This expression accurately represents 792 as a product of its prime factors.

Expressed in Ascending Order

Prime factors are typically written in ascending order for clarity and standardization. For 792:

- Prime factors in ascending order: 2, 3, 11

- Prime factorization in exponential form:

$$792 = 2^3 \times 3^2 \times 11$$

This concise expression showcases the prime breakdown neatly.

Verification of the Prime Factorization

It's important to verify the accuracy of the factorization. Let's multiply the prime factors back together:

- $2^3 = 2 \times 2 \times 2 = 8$
- $3^2 = 3 \times 3 = 9$

Multiply all:

- $8 \times 9 = 72$
- $72 \times 11 = 792$

Since the product matches the original number, the prime factorization is correct.

Significance of Prime Factorization

Expressing 792 as a product of prime factors is not just an academic exercise; it has practical applications:

1. Simplifying Fractions:

- For example, to simplify the fraction $792/132$, prime factorization helps identify common factors.

2. Finding the GCD and LCM:

- The GCD of two numbers can be found by multiplying the lowest powers of common prime factors.
- The LCM involves taking the highest powers of all prime factors.

3. Number Properties:

- Prime factorization reveals divisibility properties, the number of factors, and the number's structure.

Related Concepts and Applications

Understanding the prime factors of 792 opens doors to various mathematical concepts:

1. Divisibility Rules

- Recognizing prime factors helps quickly determine divisibility, for example:
- Divisible by 2 (since even)
- Divisible by 3 (sum of digits divisible by 3)
- Divisible by 11 (difference between the sum of the digits in odd and even positions is a multiple of 11)

2. Prime Factorization of Related Numbers

- Extending the process to other numbers, such as 396, 1188, etc., involves similar steps.

3. Prime Factorization Trees

- A visual method to understand the breakdown process, illustrating the division steps hierarchically.

4. Prime Factorization in Algebra and Number Theory

- Used in solving equations, simplifying algebraic expressions, and proving theorems.

Practice Problems for Mastery

To reinforce understanding, here are some practice exercises:

- Problem 1: Find the prime factorization of 630.

- Problem 2: Express 1024 as a product of its prime factors.
- Problem 3: Determine the GCD of 792 and 924 using prime factorization.
- Problem 4: Find the LCM of 792 and 924.

Common Mistakes to Avoid

While performing prime factorization, be cautious of:

- Stopping too early; always check divisibility thoroughly.
- Forgetting prime factors, especially when multiple divisions are involved.
- Mixing up multiplication and division signs.
- Not verifying the final product by multiplication.

Conclusion

Expressing 792 as a product of its prime factors is a fundamental skill that exemplifies the beauty and utility of prime decomposition. The process involves systematic division by the smallest primes, careful verification, and organized presentation. The prime factorization of 792 is:

$$792 = 2^3 \times 3^2 \times 11$$

Expressed in ascending order of prime factors:

2, 3, 11

This breakdown not only clarifies the structure of 792 but also equips learners with a vital tool for various mathematical applications, from simplifying fractions to exploring number properties. Mastery of prime factorization enhances problem-solving efficiency and deepens understanding of the foundational elements of integers.

In summary, understanding how to express 792 as a product of its prime factors involves a methodical approach—dividing by the smallest primes, verifying divisibility, and organizing factors in ascending order. This process exemplifies the elegance of number theory and serves as a cornerstone for many advanced mathematical concepts.

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