

Two Integers, N And P, Have A Product Of 24.

What Is The Lowest Possible Sum Of N And P?

Explain/show

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Understanding the relationship between multiplication and addition is fundamental in mathematics, especially when working with integers. The problem of finding two integers, N and P, such that their product is a specific number—in this case, 24—and determining the minimum possible sum of these integers is a classic example of solving equations with given constraints.

This article delves into this problem, exploring the various integer pairs that satisfy the product condition and identifying which pair yields the lowest sum. Along the way, we will understand the importance of factors, divisors, and the role of positive and negative numbers in such problems. Whether you're a student seeking to improve your algebra skills or a math enthusiast, this comprehensive guide will clarify the problem-solving process and provide clear explanations to enhance your understanding.

Understanding the Problem

The problem states:

> Two integers, N and P, have a product of 24. What is the lowest possible sum of N and P?

Explain/show.

Let's break down what this means:

- Two integers, N and P: These are the two numbers we're working with.
- Product of 24: $N \times P = 24$.
- Lowest possible sum: Among all pairs (N, P) that satisfy the product condition, find the pair where $N + P$ is minimized.

This problem involves two main tasks:

1. Identifying all pairs of integers whose product is 24.
2. Calculating their sums and determining which sum is the smallest.

Factors of 24 and Possible Integer Pairs

To find all pairs of integers whose product is 24, we need to understand the concept of factors.

What Are Factors?

Factors are numbers that evenly divide another number. For example, the factors of 24 are numbers that divide 24 without leaving a remainder. These are:

- 1, 2, 3, 4, 6, 8, 12, 24

Since the product of the two integers is 24, the pairs (N, P) are essentially the factor pairs of 24.

Positive Factor Pairs of 24

The positive factor pairs of 24 are:

1. (1, 24)
2. (2, 12)
3. (3, 8)
4. (4, 6)

Because multiplication is commutative, these pairs are interchangeable; for example, (1, 24) and (24, 1) are the same in terms of their product.

Negative Factor Pairs of 24

Since negative numbers multiply to a positive number when both are negative, the negative factor pairs of 24 are:

1. (-1, -24)
2. (-2, -12)
3. (-3, -8)
4. (-4, -6)

These pairs also satisfy the product condition because multiplying two negatives yields a positive.

Calculating the Sum of Each Pair

Now, we'll compute the sum for each pair and identify which sum is the lowest.

Positive pairs and their sums

Pair	Sum (N + P)
(1, 24)	$1 + 24 = 25$
(2, 12)	$2 + 12 = 14$
(3, 8)	$3 + 8 = 11$
(4, 6)	$4 + 6 = 10$

Negative pairs and their sums

Pair	Sum (N + P)
(-1, -24)	$-1 + (-24) = -25$
(-2, -12)	$-2 + (-12) = -14$
(-3, -8)	$-3 + (-8) = -11$
(-4, -6)	$-4 + (-6) = -10$

Identifying the Lowest Sum

In the context of the problem, the lowest sum refers to the smallest numerical value, which could be negative or positive depending on the pairs.

- Among the positive pairs, the smallest sum is 10 (from the pair (4, 6)).
- Among the negative pairs, the smallest sum is -25 (from the pair (-1, -24)).

Since the question asks for the lowest possible sum, and considering that negative sums are less than positive sums, the pair (-1, -24) yields the lowest sum of -25.

Therefore, the pair (-1, -24) satisfies the condition of having a product of 24 and yields the lowest possible sum, which is -25.

Conclusion: Final Answer and Explanation

The lowest possible sum of two integers N and P with a product of 24 is -25, achieved when $N = -1$ and $P = -24$.

This conclusion is based on examining all factor pairs of 24, including negative pairs, and calculating their sums. Negative pairs produce sums that are less than any positive pair because adding two negative numbers results in a more negative sum.

This problem illustrates the importance of considering both positive and negative factors when dealing with integer equations. It also demonstrates how understanding factors and their properties can lead to efficient solutions in algebraic problems.

Additional Insights and Tips for Similar Problems

- Always consider both positive and negative factors when solving for integer solutions involving multiplication.
- To find the pair with the lowest sum, look for negative factor pairs first because they tend to produce the smallest (most negative) sums.
- Remember that the absolute value of the factors influences the sum; larger absolute values tend to produce more negative sums when both factors are negative.
- Practice with different products to strengthen your understanding of factor pairs and their sums.

Summary

Step	Explanation
1.	Find all factor pairs of 24 (positive and negative). (1, 24), (2, 12), (3, 8), (4, 6) and their negatives.
2.	Calculate the sum for each pair. Compute $N + P$ for each pair.
3.	Identify the smallest sum. Negative pairs produce sums less than positive pairs; (-1, -24) yields -25.
4.	Conclusion. The pair (-1, -24) gives the lowest sum: -25.

This problem exemplifies key algebraic concepts such as factors, divisibility, and the importance of considering negative solutions to find optimal answers in mathematical problems involving integers.

By understanding these principles and steps, students and math enthusiasts can confidently approach

similar problems involving products and sums of integers.

Frequently Asked Questions

Two integers, N and P, have a product of 24. What is the lowest possible sum of N and P?

The lowest possible sum occurs when N and P are the factors of 24 that are closest in value and both are negative, since negative factors produce a positive product. The pairs are (-1, -24), (-2, -12), (-3, -8), (-4, -6). Their sums are -25, -14, -11, and -10 respectively. The lowest sum is -25 from (-1, -24).

Why do negative integers produce a lower sum than positive integers when their product is 24?

Because when both integers are negative, their product remains positive, but their sums become negative. Since negative sums are less than positive sums, the lowest possible sum is achieved with negative integer pairs.

Which factor pairs of 24 give the minimum sum of $N + P$?

The negative factor pairs of 24 that give the minimum sum are (-1, -24), which sum to -25, and others like (-2, -12), (-3, -8), and (-4, -6). Among these, -25 is the lowest sum.

Can the sum of N and P be positive if their product is 24?

Yes, if both numbers are positive, such as (1, 24), the sum is 25, which is positive. However, this does not give the lowest possible sum; negative pairs yield lower sums.

How do you determine the factors of 24 that produce the lowest sum

of N and P?

List all factor pairs of 24, including negative ones, and calculate their sums. The pair with the most negative sum will give the lowest possible sum of N and P.

Is it necessary for N and P to be integers to find the lowest sum with a product of 24?

Yes, because the problem specifies integers. For non-integer solutions, the concept of minimum sum would be different, but here, we focus on integer pairs.

What is the mathematical approach to solving for the lowest sum given $N \cdot P = 24$?

Express P as 24 divided by N ($P = 24/N$), then consider integer values of N that divide 24 and calculate $N + P$. The lowest sum corresponds to the pair where N and P are both negative factors with the greatest absolute difference.

What is the final answer for the lowest possible sum of N and P when their product is 24?

The lowest possible sum of N and P is -25, achieved when $N = -1$ and $P = -24$.

Additional Resources

Two Integers, N And P, Have A Product Of 24. What Is The Lowest Possible Sum Of N And P?

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Introduction: Understanding the Problem

When exploring basic algebraic problems, one fundamental concept revolves around the relationship between two numbers—specifically, their product and sum. The problem at hand is both classic and instructive: Two integers, N and P , have a product of 24. What is the lowest possible sum of N and P ?

This question invites us to analyze the integer factors of 24 and determine the pair that yields the minimum sum. At first glance, it might seem straightforward—simply list the pairs, compute their sums, and identify the smallest. However, the problem's depth extends beyond mere listing. It involves understanding factorization, the properties of integers, and the role of positive versus negative factors. Furthermore, the question implicitly challenges us to consider all possible scenarios, including negative integers, to find the minimal sum.

In this article, we will systematically explore the problem, analyze potential solutions, and arrive at a definitive conclusion. We will also delve into the mathematical principles underlying the problem, including factorization, the behavior of positive and negative integers, and the symmetry of solutions.

Understanding the Constraints and Variables

Before diving into calculations, it is essential to clarify the constraints and variables involved:

- Variables: N and P , both integers.
- Product Constraint: $N \times P = 24$.
- Objective: Minimize the sum $S = N + P$.

Given these parameters, our goal is to identify the pair (N, P) that satisfies the product constraint while producing the lowest possible sum.

Key considerations:

1. Nature of integers: Both N and P are integers, meaning they can be positive, negative, or zero.
2. Zero possibility: Since their product is 24, which is non-zero, neither N nor P can be zero.
3. Sign of integers: The product of two integers is positive if both are positive or both are negative; hence, solutions could involve positive pairs or negative pairs.

Next, we will analyze the positive factor pairs of 24, followed by the negative ones, to explore all possibilities comprehensively.

Factor Pairs of 24: Listing All Possible Combinations

The first step toward solving the problem involves enumerating all integer pairs (N, P) such that $N \times P = 24$. Since 24 is a positive integer, its factors include both positive and negative integers, in pairs.

Positive factor pairs of 24:

- (1, 24)
- (2, 12)
- (3, 8)
- (4, 6)

In each pair, the order can be reversed, but since addition is commutative, the sum remains the same regardless of order. So, the key pairs are:

Pair (N, P)	Sum N + P
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(1, 24)	25
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(2, 12)	14
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(3, 8)	11
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(4, 6)	10
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Next, evaluate the negative counterparts, as negative integers also produce a product of 24 when both are negative:

Negative factor pairs of 24:

- (-1, -24)

- (-2, -12)

- (-3, -8)

- (-4, -6)

Calculating their sums:

Pair (N, P)	Sum N + P
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(-1, -24)	-25
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(-2, -12)	-14
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(-3, -8)	-11
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(-4, -6)	-10
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From these calculations, it's evident that the negative pairs yield negative sums, which are smaller than positive sums. Since the goal is to find the lowest possible sum, these negative pairs are promising candidates.

Summary of candidate sums:

- Positive pairs: minimum sum is 10 (from (4, 6))

- Negative pairs: minimum sum is -25 (from (-1, -24))

Clearly, among these, the lowest sum (most negative) is -25, achieved with the pair (-1, -24).

Analyzing the Results: Which Pair Produces the Lowest Sum?

Based on the enumeration:

- The pair $(-1, -24)$ produces a sum of -25 .
- This sum is less than any positive sum listed.
- Since the problem asks for the lowest possible sum, and negative sums are less than positive sums, the pair $(-1, -24)$ is the optimal solution.

Implication:

- The minimal sum of N and P , given their product of 24 , is -25 .
- Corresponding to $N = -1$ and $P = -24$ (or vice versa).

This analysis confirms that negative integers, specifically the pair $(-1, -24)$, produce the smallest sum.

Mathematical Explanation and Underlying Principles

While the enumeration approach is straightforward, understanding why negative pairs produce the minimal sum requires examining the properties of multiplication and addition.

1. Sign considerations:

- When two integers are both positive, their sum is positive.
- When both are negative, their sum is negative.
- To minimize the sum (make it as small as possible), the negative pair with the greatest magnitude (absolute value) will produce the most negative sum.

2. Absolute value and the sum:

- The sum of two negative numbers, N and P , with product 24, is minimized when $|N| + |P|$ is maximized.
- Since $N \times P = 24$, and both are negative, N and P are factors of 24 in magnitude, just negative.

3. Relationship between factors and sum:

- For negative factors, $N = -a$, $P = -b$, with $a \times b = 24$.
- Sum: $N + P = -a - b = -(a + b)$.
- To minimize $N + P$, we need to maximize $a + b$, which occurs when the factors a and b are the pair with the largest sum.

In our case, the pair $(-1, -24)$:

- $|N| = 1$, $|P| = 24$
- Sum: $N + P = -1 - 24 = -25$

This is the most negative sum because any other factor pair yields a less negative sum.

4. Alternative approach:

- The problem can be viewed geometrically or algebraically, considering the quadratic equation:

$$N \times P = 24$$

$$\Rightarrow P = 24 / N$$

- The sum $S = N + P = N + 24 / N$
- To find the minimum of S , differentiate with respect to N (considering N as a real number), but since N must be an integer, we can analyze the function over integer values.
- The minimal sum occurs at N that minimizes $S = N + 24 / N$. The critical point in the real domain is

at $N = \sqrt{24}$, but since N must be integer, the closest candidates are $N = 4$, $N = -4$, $N = 1$, $N = -1$, etc.

- For $N = 1$: $\text{sum} = 1 + 24/1 = 25$
- For $N = -1$: $\text{sum} = -1 + 24 / -1 = -1 - 24 = -25$

This aligns with our earlier enumeration.

Conclusion: The Final Answer and Its Significance

After thorough analysis, the conclusion is clear:

The lowest possible sum of two integers N and P , such that their product is 24, is -25.

This minimum sum is achieved when:

- $N = -1$
- $P = -24$

or vice versa.

Implications:

- The problem illustrates the importance of considering negative factors when seeking extremal values in algebraic problems.
- It demonstrates how the interplay between multiplication and addition influences the solutions.
- It showcases the value of enumeration combined with algebraic reasoning to solve factorization problems.

Broader Context and Mathematical Significance

While this problem may seem straightforward, it encapsulates several fundamental mathematical concepts:

- Factorization: Understanding how integers can be broken down into factors, both positive and negative.
- Sign analysis: Recognizing the impact of signs on multiplication and addition.
- Optimization: Applying reasoning to find minimal or maximal values under given constraints.
- Symmetry in solutions: Noticing that reversing factors doesn't change the product but affects the sum.

Such problems are foundational in algebra and number theory, serving as stepping stones to more complex topics like quadratic equations, Diophantine equations, and optimization problems.

Final Thoughts

In summary, the problem of finding the minimum sum of two integers with a fixed product is an elegant illustration of basic algebraic principles. The key takeaway is that negative factors can produce more extreme sums—both positive and negative—than their positive counterparts. By systematically examining all factor pairs, considering signs, and employing algebraic reasoning, we have determined that -25 is the lowest possible sum, achieved by the pair $(-1, -24)$.

This problem underscores the importance of comprehensive analysis in mathematics, where considering all scenarios ensures the most accurate and insightful solutions. Whether for students, educators, or enthusiasts, it exemplifies how simple questions can uncover rich

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