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Understanding the Problem: Combining Functions $F(x)$ and $G(x)$

When working with functions in algebra, one common task is to find the sum of two functions. Given two functions:

- $F(x) = 4x + 1$
- $G(x) = 3x + 2$

the goal is to determine the combined function:

- $(x) = F(x) + G(x)$

This process involves understanding how to add functions and simplify the resulting expression. Let's walk through the steps carefully.

Step 1: Clarify the Functions involved

Before performing any operations, it's essential to understand the functions:

Function $F(x)$:

- A linear function with a slope of 4
- Y-intercept at 1

Function $G(x)$:

- A linear function with a slope of 3
- Y-intercept at 2

Step 2: Write Down the Sum of the Functions

The combined function, often called the sum function, is:

$$- (x) = F(x) + G(x)$$

Substituting the given functions:

$$- (x) = (4x + 1) + (3x + 2)$$

Step 3: Simplify the Expression

To find the explicit form of (x) , combine like terms:

Combine the x-terms:

$$- 4x + 3x = 7x$$

Combine the constant terms:

$$- 1 + 2 = 3$$

Therefore,

$$- (x) = 7x + 3$$

This is the resulting function, representing the sum of $F(x)$ and $G(x)$.

Step 4: Verify the Result

It's good practice to verify your result by plugging in a specific value of x :

Suppose $x = 2$:

$$- F(2) = 4(2) + 1 = 8 + 1 = 9$$

$$- G(2) = 3(2) + 2 = 6 + 2 = 8$$

Sum:

$$- F(2) + G(2) = 9 + 8 = 17$$

Using the combined function:

$$- (2) = 7(2) + 3 = 14 + 3 = 17$$

The verification confirms our combined function is correct.

Key Concepts in Combining Functions

Understanding how to add functions is fundamental in algebra and calculus. Here are some key points:

1. Adding Functions

- To add two functions, combine their corresponding expressions by adding like terms.
- The sum function reflects the combined effect of both functions on the variable x .

2. Combining Like Terms

- Like terms are terms with the same variable raised to the same power.
- For linear functions, this means adding the coefficients of x and the constants separately.

3. General Formula for Sum of Linear Functions

- Given $F(x) = m_1x + b_1$ and $G(x) = m_2x + b_2$
- Their sum is: $(x) = (m_1 + m_2)x + (b_1 + b_2)$

Applying this to our functions:

- $m_1 = 4$, $b_1 = 1$
- $m_2 = 3$, $b_2 = 2$

Sum:

$$- (x) = (4 + 3)x + (1 + 2) = 7x + 3$$

Applications of Function Addition in Real Life

Adding functions is not just a mathematical exercise; it has practical applications across various fields:

1. Economics

- Calculating total revenue by combining different revenue functions.

2. Physics

- Summing forces or velocities represented by functions.

3. Engineering

- Combining signal functions or system responses.

4. Data Analysis

- Merging datasets modeled by different functions to analyze combined effects.

Further Practice: Combining Other Types of Functions

While linear functions are straightforward, more complex functions also require combining techniques.

1. Polynomial Functions

- Add corresponding coefficients of similar degree terms.

2. Rational Functions

- Combine by finding common denominators, then adding numerators.

3. Exponential and Logarithmic Functions

- Usually involve more complex operations, but the principle remains: combine like terms or expressions where applicable.

Summary: How to Find $(x) = F(x) + G(x)$

To find the sum of two functions:

1. Write down the functions explicitly.
2. Add the functions by combining like terms:
 - Coefficients of x
 - Constant terms
3. Simplify the expression to its simplest form.
4. Verify with specific values to ensure correctness.

In our example:

- $F(x) = 4x + 1$
- $G(x) = 3x + 2$

The sum:

- $(x) = 7x + 3$

This process is fundamental in algebra and serves as a building block for more advanced topics.

Conclusion

Understanding how to combine functions like $F(x)$ and $G(x)$ is essential for mastering algebraic concepts. The process involves straightforward addition of coefficients and constants. Whether you're working on simple linear functions or more complex mathematical models, the principles remain consistent. Remember to verify your results with specific x -values to ensure accuracy. By practicing these techniques, you'll build a solid foundation for advanced mathematics, including calculus, statistics, and engineering applications.

Keywords: combine functions, $F(x)$, $G(x)$, algebra, linear functions, function addition, simplifying expressions, mathematical operations, algebraic techniques, applications of functions

Frequently Asked Questions

What is the combined function (x) if $F(x) = 4x$ and $G(x) = 3x + 2$?

$$(x) = F(x) + G(x) = 4x + (3x + 2) = 7x + 2.$$

How do you find the sum of two functions $F(x)$ and $G(x)$?

To find the sum, add the expressions for $F(x)$ and $G(x)$ algebraically: $(F + G)(x) = F(x) + G(x)$.

If $F(x) = 4x$ and $G(x) = 3x + 2$, what is the value of (x) at $x = 5$?

$$\text{At } x = 5, (x) = 7(5) + 2 = 35 + 2 = 37.$$

Can you simplify the sum of two linear functions like $F(x)$ and $G(x)$?

Yes, the sum of two linear functions is also linear and can be simplified by combining like terms, resulting in a new linear function.

What does the notation $(x) = F(x) + G(x)$ represent?

It represents the combined or resultant function obtained by adding the outputs of $F(x)$ and $G(x)$ for any input x .

How is the slope of the resulting function $(x) = 7x + 2$ related to the original functions?

The slope of $(x) = 7x + 2$ is the sum of the slopes of $F(x)$ and $G(x)$: $4 + 3 = 7$.

What is the significance of the $+2$ in the combined function $(x) = 7x + 2$?

The $+2$ is the combined constant term, resulting from the addition of the constant terms in $G(x)$ and any constant in $F(x)$.

Additional Resources

Investigating the Function Composition and Summation of $F(x) = 4x$ and $G(x) = 3x + 2$

In the realm of algebra and functional analysis, understanding how functions interact through operations such as addition and composition is fundamental. This article delves into the specific case of two linear functions, $F(x) = 4x$ and $G(x) = 3x + 2$, exploring their

sum, composition, and the underlying principles that govern these operations. The focus is on providing a comprehensive, detailed examination suitable for educational review, academic study, and practical applications.

Introduction to Function Operations

Functions are mathematical entities that assign a unique output to each input within a domain. When multiple functions are involved, mathematicians often explore how they combine via various operations—addition, subtraction, multiplication, division, and composition.

- Addition of Functions: Combining two functions, F and G , to create a new function $(F + G)(x) = F(x) + G(x)$.
- Function Composition: Applying one function to the result of another, denoted as $(F \circ G)(x) = F(G(x))$ or $(G \circ F)(x) = G(F(x))$.

Understanding these operations provides insight into the structure of complex functions, their properties, and their potential for modeling real-world phenomena.

Defining the Functions $F(x)$ and $G(x)$

Given functions:

- $F(x) = 4x$
- $G(x) = 3x + 2$

Both are linear functions, implying their graphs are straight lines with constant slopes and intercepts.

Properties:

- $F(x)$ has a slope of 4 and passes through the origin.
- $G(x)$ has a slope of 3 and a y-intercept at 2.

The linearity simplifies many operations, allowing for straightforward algebraic manipulation and interpretation.

Part 1: Calculating $(F + G)(x) = F(x) + G(x)$

The first operation under consideration is the sum of the two functions.

Step-by-Step Calculation

1. Write the sum explicitly:

$$(F + G)(x) = F(x) + G(x)$$

2. Substitute the given functions:

$$(F + G)(x) = 4x + (3x + 2)$$

3. Combine like terms:

$$(F + G)(x) = 4x + 3x + 2$$

4. Simplify:

$$(F + G)(x) = (4x + 3x) + 2 = 7x + 2$$

Result:

$$> (F + G)(x) = 7x + 2$$

This function is also linear, with a slope of 7 and a y-intercept of 2.

Implications of the Sum Function

- Slope: The combined slope is the sum of individual slopes ($4 + 3 = 7$), indicating the rate of change doubles when functions are added.
- Intercept: The y-intercept remains at 2, the same as $G(x)$, because the constant term in $F(x)$ is zero.

This straightforward calculation underscores a key property:

> The sum of two linear functions results in another linear function, with the slope being the sum of the individual slopes and the intercept being the sum of the individual intercepts (if any).

Part 2: Exploring Function Composition

While the primary focus is on the sum, understanding how these functions compose reveals deeper structural insights.

Definition of Composition: $(F \circ G)(x)$ and $(G \circ F)(x)$

- $(F \circ G)(x)$: Apply G first, then F:

$$(F \circ G)(x) = F(G(x))$$

- $(G \circ F)(x)$: Apply F first, then G:

$$(G \circ F)(x) = G(F(x))$$

Calculating $(F \circ G)(x)$

1. Compute $G(x)$:

$$G(x) = 3x + 2$$

2. Apply F to $G(x)$:

$$F(G(x)) = 4 G(x) = 4 (3x + 2)$$

3. Distribute:

$$F(G(x)) = 4 \cdot 3x + 4 \cdot 2 = 12x + 8$$

Result:

$$> (F \circ G)(x) = 12x + 8$$

Calculating $(G \circ F)(x)$

1. Compute $F(x)$:

$$F(x) = 4x$$

2. Apply G to $F(x)$:

$$G(F(x)) = 3 F(x) + 2 = 3 (4x) + 2$$

3. Simplify:

$$G(F(x)) = 12x + 2$$

Result:

> $(G \circ F)(x) = 12x + 2$

Analyzing the Composition Results

Both compositions produce linear functions with the same slope of 12 but different intercepts:

- $(F \circ G)(x) = 12x + 8$
- $(G \circ F)(x) = 12x + 2$

This highlights a fundamental aspect of function composition:

- Non-commutativity: In general, $(F \circ G)(x) \neq (G \circ F)(x)$.
- Difference in intercepts: Reflects the order of application affecting the constant term.

Significance:

- The composition increases the slope to 12, which is the product of the individual slopes ($4 \cdot 3 = 12$).
- The intercept varies depending on the order, indicating the importance of operation sequence.

Graphical Interpretation and Practical Implications

Visualizing these functions enhances comprehension:

- The sum function, $(F + G)(x) = 7x + 2$, is a line with a moderate slope, intersecting the y-axis at 2.
- The compositions, $(F \circ G)(x)$ and $(G \circ F)(x)$, are lines with steeper slopes (12), differing in intercepts, which affects their vertical positioning.

Applications in Real-World Modeling:

- Economics: Combining cost functions or revenue models.
- Physics: Analyzing compounded rates or sequential transformations.
- Engineering: Signal processing where multiple filters or transformations are combined.

Understanding these operations enables practitioners to model complex systems accurately.

Generalized Insights and Mathematical Significance

The specific case of $F(x) = 4x$ and $G(x) = 3x + 2$ provides a microcosm of broader principles:

- Linearity: The sum and composition of linear functions remain linear.
- Additivity and Multiplicativity: Slope addition under summation; slope multiplication under composition.
- Order Sensitivity: Composition order affects the intercept and overall function.

These principles extend beyond linear functions, serving as foundational concepts in higher mathematics, calculus, and functional analysis.

Conclusion

By thoroughly analyzing the functions $F(x) = 4x$ and $G(x) = 3x + 2$, we observe that:

- Their sum produces a new linear function with combined slope and intercept: $(F + G)(x) = 7x + 2$.
- Their compositions yield functions with a compounded slope of 12 but differing intercepts depending on the order:
 - $(F \circ G)(x) = 12x + 8$
 - $(G \circ F)(x) = 12x + 2$

This exploration highlights the elegant interplay of linear functions, showcasing how simple algebraic operations reveal profound structural properties. Such understanding is instrumental in various scientific, engineering, and economic applications, where modeling complex systems often hinges on the manipulation and composition of fundamental functions.

Future directions include extending these concepts to non-linear functions, exploring inverse functions, and analyzing the impact of these operations within function spaces, further enriching our grasp of mathematical structures.

In summary, the investigation into $F(x) = 4x$ and $G(x) = 3x + 2$ exemplifies the core principles of function addition and composition, illustrating how these operations shape the behavior and properties of mathematical models.

If $F(x) = 4x - 1$ And $G(x) = 3x - 2$ A Find $F(x) \cdot G(x)$

If $F(x) = 4x - 1$ And $G(x) = 3x - 2$ A Find $F(x) \cdot G(x)$

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