Function Chain Lab

Build composites, then track their inputs and outputs.

HIGH SCHOOL · MA.912.F.3.4

MA.912.F.3.4 "Represent the composition of two functions algebraically or in a table. Determine the domain and range of the composite function."

NAME ______________________ DATE ____________

FOLLOW THE FUNCTION ORDER

To find f(g(x)), apply g first, then use its output as the input of f. The composite domain includes only inputs allowed by g whose outputs are also allowed by f. Find the range by identifying all outputs the composite can produce.

WORKED EXAMPLE

Let f(x) = 11x - 7 and g(x) = x + 13. Find f(g(x)). State the domain and range.

1. Start with f(g(x)).
2. Substitute g(x): f(x + 13) = 11(x + 13) - 7.
3. Simplify: 11x + 143 - 7 = 11x + 136.

Answer: f(g(x)) = 11x + 136; domain: all real numbers; range: all real numbers.

PRACTICE

6 problems

1. Let f(x) = 2x + 5 and g(x) = x^2. Find f(g(x)). State the domain and range.

   ANSWER ______________________

2. Let f(x) = sqrt(x + 1) and g(x) = 4 - x. Find f(g(x)). State the domain and range.

   ANSWER ______________________

3. Let f(x) = 1/(x - 6) and g(x) = 3x. Find f(g(x)). State the domain and range.

   ANSWER ______________________

4. Use the tables to make a table for f(g(x)). Then state the domain and range. g table: x | -4 | 0 | 6 g(x) | 2 | 8 | 10 f table: x | 2 | 8 | 10 f(x) | -1 | 9 | -1

   ANSWER ______________________

5. Let f(x) = |x| and g(x) = x - 9. Find f(g(x)). State the domain and range.

   ANSWER ______________________

6. Let f(x) = x^2 with domain [-2, 4], and let g(x) = x + 1 with domain [-5, 3]. Find f(g(x)). State the domain and range of the composite.

   ANSWER ______________________

APPLY IT
Show your work

1 A gaming club awards g(x) = 6x + 8 tokens after x matches, where 0 <= x <= 4. Its prize counter uses f(x) = x/2 to convert tokens into prize credits, and f is defined for 0 <= x <= 40. Write the composite function that maps matches to prize credits. State its domain and range.

WORK SPACE

ANSWER ____________________

2 A game tournament records x bonus points, where 0 <= x <= 16. The organizer adds 4 entry points using g(x) = x + 4. A badge level is found with f(x) = sqrt(x - 4), defined for x >= 4. Write the composite function that maps bonus points to badge level. State its domain and range.

WORK SPACE

ANSWER ____________________

CHALLENGE
One step up

CHALLENGE

Let f(x) = sqrt(x + 2) and g(x) = 1/(x - 1). Find f(g(x)). State the domain and range of the composite. Explain why sqrt(2) is not in the range.

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ANSWER KEY **Function Chain Lab** HIGH SCHOOL · MA.912.F.3.4

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Let f(x) = 2x + 5 and g(x) = x^2. Find f(g(x)). State the domain and range.	**f(g(x)) = 2x^2 + 5; domain: all real numbers; range: [5, infinity).**
2	Let f(x) = sqrt(x + 1) and g(x) = 4 - x. Find f(g(x)). State the domain and range.	**f(g(x)) = sqrt(5 - x); domain: (-infinity, 5]; range: [0, infinity).**
3	Let f(x) = 1/(x - 6) and g(x) = 3x. Find f(g(x)). State the domain and range.	**f(g(x)) = 1/(3x - 6); domain: x != 2; range: y != 0.**
4	Use the tables to make a table for f(g(x)). Then state the domain and range. g table: x | -4 | 0 | 6 g(x) | 2 | 8 | 10 f table: x | 2 | 8 | 10 f(x) | -1 | 9 | -1	**f(g(x)) table: x | -4 | 0 | 6; f(g(x)) | -1 | 9 | -1. Domain: {-4, 0, 6}; range: {-1, 9}.**
5	Let f(x) = |x| and g(x) = x - 9. Find f(g(x)). State the domain and range.	**f(g(x)) = |x - 9|; domain: all real numbers; range: [0, infinity).**
6	Let f(x) = x^2 with domain [-2, 4], and let g(x) = x + 1 with domain [-5, 3]. Find f(g(x)). State the domain and range of the composite.	**f(g(x)) = (x + 1)^2; domain: [-3, 3]; range: [0, 16].**

PART 2 · APPLY IT

1. **f(g(x)) = 3x + 4; domain: [0, 4]; range: [4, 16].** Substitute 6x + 8 into f(x) = x/2. The match limit gives the domain, and evaluating the linear composite at the endpoints gives the range.
2. **f(g(x)) = sqrt(x); domain: [0, 16]; range: [0, 4].** Substitute x + 4 into sqrt(x - 4), which gives sqrt(x). The given bonus-point interval determines the domain, and square roots from 0 through 16 produce outputs from 0 through 4.

CHALLENGE

f(g(x)) = sqrt(1/(x - 1) + 2). Domain: (-infinity, 1/2] union (1, infinity). Range: [0, sqrt(2)) union (sqrt(2), infinity). The output sqrt(2) would require g(x) = 0, but 1/(x - 1) can never equal 0.

Accept equivalent composite forms, equivalent interval notation, and set-builder notation for excluded values. For domains, students must exclude any input that makes the inner function undefined or produces an input outside the outer function's domain.