Mathematics I

Composing Functions

Option #1 Performance Task | Student Document

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Directions

Please review the task below and answer the various questions within the task to the best of your ability. If needed, you may have an adult or peer read the task out loud to aid your understanding. You may use tools and embedded resources such as word walls, notebooks, word banks, and a glossary to support your understanding of concepts. These tools must be used independently without the support of a peer or teacher. Additionally, feel free to use the following resources when answering each item:

- drawing the visual representations of the functions in Part 1 or table cells in Part 2 using graph paper and pen or pencil
- using graphing software in Part 1 such as GeoGebra, Desmos, or a graphing calculator to digitally create graphs to demonstrate the functions
- using a digital program in Part 2 to create the tables
- using verbal or written expression options to describe their answers
- using text-to-speech or speech-to-text software to answer questions
- dictating to a scribe[1]

Word Bank. Here are some words that might help you in explaining your thinking for the questions in this task. (You will probably not use every word for every question, so pick and choose the words that make sense for each question.)

function	translation	vertical stretch	horizontal stretch	vertical shrink
horizonal shrink	sequence	term	recursive	

[1] In this situation, it is important for the scribe to be careful to record **only** what the student explicitly communicates, rather than making interpretations and "filling in the blanks" based on what they think the student meant.

PART 1. Build and Explore New Functions: Composing Functions

Item 1. Directions

For Item 1, complete the task below.

Your knowledge of the following math concepts will be helpful in solving this task:

- function
- translation
- vertical or horizontal stretch or shrink

Item 1 Task

What is the effect on the graph of a function $f(x)$ when it is replaced by $f(x)+k$, $kf(x)$, $f(kx) \vee f(x+k)$?

For instance, consider a function such as $f(x)=x^2$ and the various functions related to $f(x)$ including

$$g(x)=(x+3)^2$$

$$k(x)=3x^2$$

$$m(x)=(3x)^2$$

$$p(x)=x^2+3$$

$$q(x)=x^2-3$$

What other equations like the ones above are possible to create?

Use the technology of your choice, such as Desmos, a graphing calculator, or an online graphing tool, to determine what the effect on the graph of the function $f(x)=x^2$ is based on the change to the equation and why that effect occurs.

Use the equations from the example above or other examples you create to answer, "What is the effect on the graph of a function $f(x)$ when it is replaced by $f(x)+k$, $kf(x)$, $f(kx) \vee f(x+k)$?"

PART 2. Sequences: The Fibonacci Sequence

The Fibonacci sequence is arguably the most recognized sequence in mathematics. The sequence was first described over 2,000 years ago and appears in nature in pine cone arrangements. The Fibonacci sequence can be described as a sequence in which each number is the sum of the preceding two numbers, with 0 and 1 as the first two numbers. Mathematically, the Fibonacci sequence can be defined recursively as $F_0 = 0$, $F_1 = 1$, and $F_n = F_{n-1} + F_{n-2}$ for $n > 1$.

Item 1. Directions

Item 1 has one task. Complete the task below.

Your knowledge of the following math concepts will be helpful in solving this task:

- sequence
- term
- recursive

Item 1 Task

Fill in table 1 below for Fibonacci's sequence. The term number is the subscript, and the term is each number in the sequence.

Table 1. Fibonacci's Sequence 1

Term Number	0	1	2	3	4	5	6	7	8	9	10
Term	0	1	1	2	3	5					

Item 2. Directions

For Item 2, complete the task below.

Item 2 Task

Consider this sequence which is defined recursively as

$$a_0 = 3;\ a_n = 2 \bullet a_{n-1}$$

The term number is the subscript, and the term is each number in the sequence.

Fill in table 2 below.

Table 2. Fibonacci's Sequence 2

Term Number	0	1	2	3	4	5
Term						

If the variable *x* represents the term number and the variable *y* represents the term, what type of function would this be and what equation would define this function?