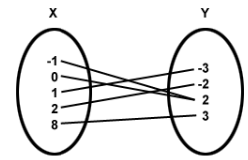
(A) Lesson Objectives

a. Review composite functions and how it can be represented numerically, algebraically and graphically.
b. Introduce graphical transformations
c. Understand that graphical transformations are formed through composite functions

(B) Introduction to Composite Functions.

Review - We have explored the multiple representations of function:

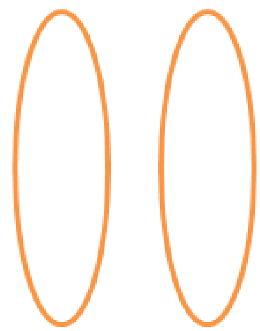


- Literal
- Numerical Data (table-of-values and mapping diagrams)
- Graphical
- Algebraic

1. Let's consider a mapping diagram. Complete the mapping diagram for the function:

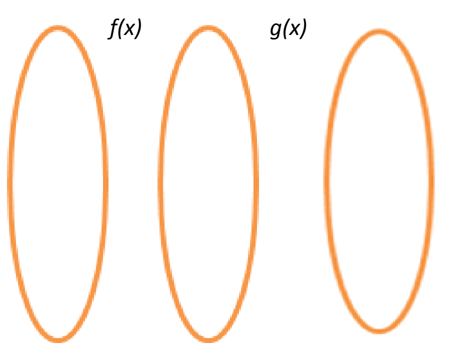
$f(x) = x^2$, where the Domain = {-3,-2,-1,0, 1, 2, 3}

What is the Range of ***f(x)*** ____________________



2. **Sometimes functions undergo more than one mapping or transformation.**

Let's consider these two functions: $f(x) = x^2$ *and* $g(x) = x - 1$, what would this mapping look like below. Let the Domain = {-3,-2,-1,0, 1, 2, 3}



Domain *Range*

Determine the Range _____________________________

If our data is mapped via f(x) and then mapped by g(x), the question then remains:

"What is the new equation of the twice mapped data that will allow us to get the same result in 1 step?"

____

3. **Notation**

Given the functions f(x) and g(x) where x is mapped via f(x) FIRST and then mapped AGAIN via g(x), then this IDEA or CONCEPT is represented by the notation: $g(f(x))$ or $g \circ f(x)$

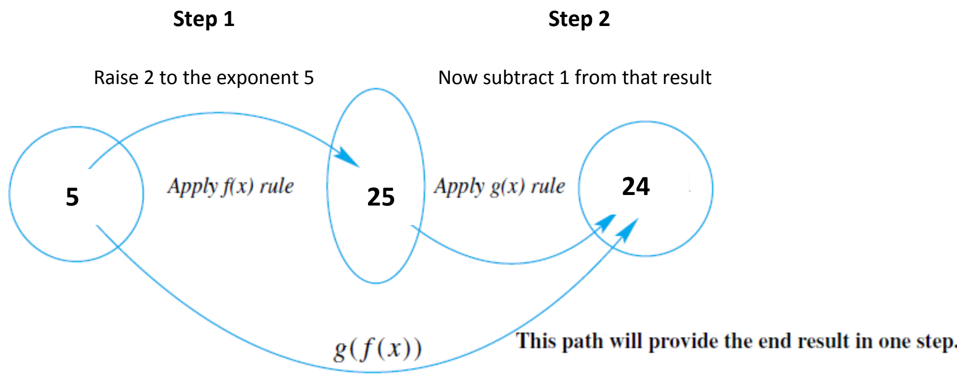
Consider the functions:

f(x) = x^2

g(x) = x - 1

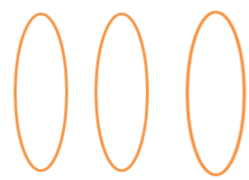
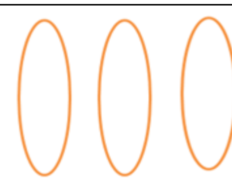
Find the value of:

$g(f(x))$ or $g \circ f(x)$

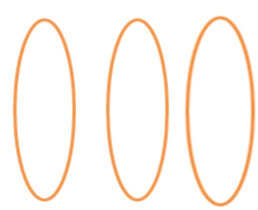
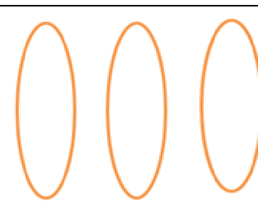


4. Working with Composite Functions

If ***f(x) = x***^{2} and ***g(x) = x + 1*** determine: *Model in a mapping diagram if needed*

$g \circ f(0)$	$g \circ f(3)$	$g \circ f(x)$	
$f \circ g(0)$	$f \circ g(3)$	$f \circ g(x)$	

If ***f(x) = x***^{2} and ***g(x) = x - 2*** determine: *Model in a mapping diagram if needed*

$f \circ g(4)$	$f \circ g(1)$	$f \circ g(x)$	
$g \circ f(4)$	$g \circ f(1)$	$g \circ f(x)$	

5. **Observations:** What are the key things I have noticed about composite functions?

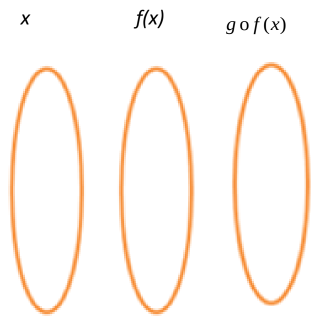
(C) Graphical Representations of Composite Functions

Consider the functions:

f(x) = x² and ***g(x) = x - 4***

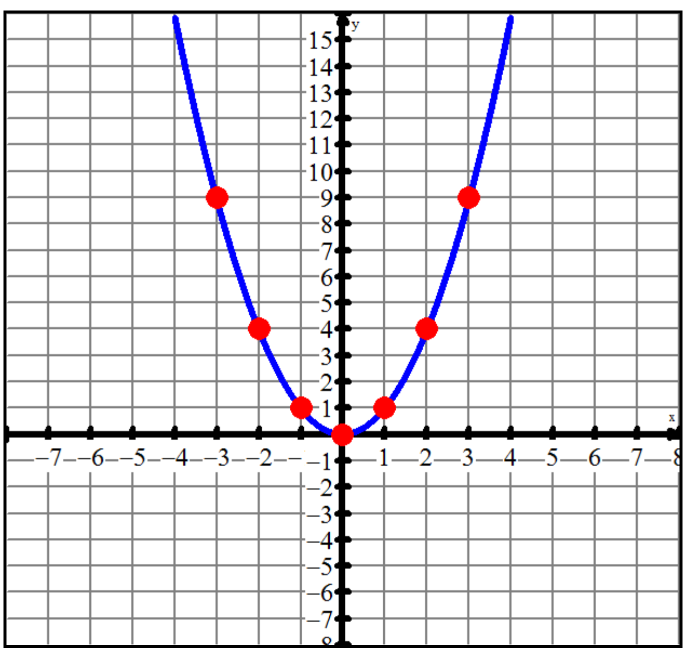
Determine $g \circ f(x)$ = ____________________

Mapping Diagram



Here is the graph of ***f(x) = x²***

Graph the function $y = g \circ f(x)$ using your GDC



Graphical transformations

How has the graph of ***f(x) = x²*** transformed to the graph of $y = g \circ f(x)$?

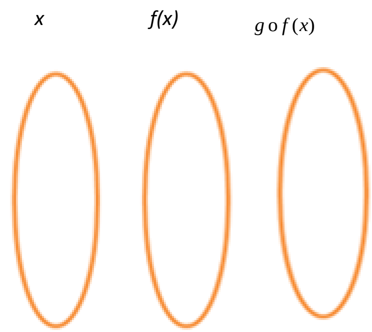
Explain graphical changes in detail.

Consider the functions:

f(x) = x^2 and ***g(x) = x + 3***

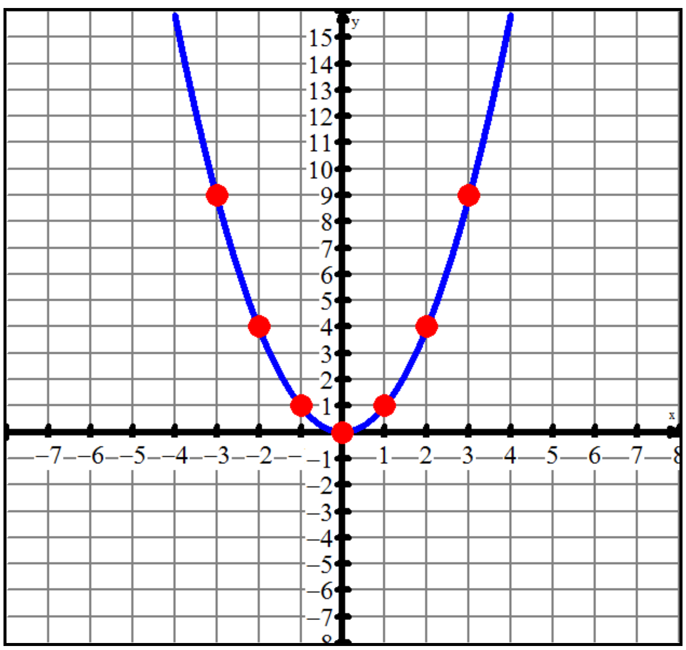
Determine $g \circ f(x)$ = ____________________

Mapping Diagram



Here is the graph of ***f(x) = x^2***

Graph the function $y = g \circ f(x)$ using your GDC



Graphical transformations

How has the graph of ***f(x) = x^2*** transformed to the graph of $y = g \circ f(x)$?

Explain graphical changes in detail.

<u>Check for Understanding:</u>

What do you think the graphical transformation would be for the function ***f(x) = x^2 - 5*** **?** Explain your thinking.

What do you think the 2 parent functions are that were composed to form ***f(x) = x^2 - 5*** **?** Justify your conjecture.

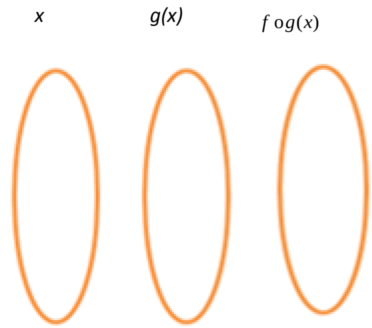
Lesson 24 - Exploring Graphical Transformations and Composite Functions   Date

Consider the functions:

f(x) = x² and ***g(x) = x - 1***

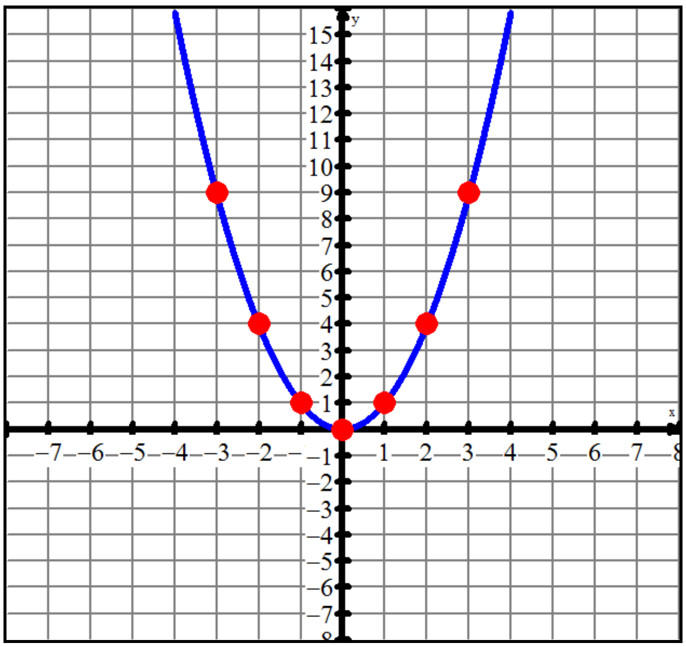
Determine $f\,o g(x)$ = ____________________

Mapping Diagram



Here is the graph of ***f(x) = x²***

Graph the function $y = f\,o g(x)$ using your GDC



Graphical transformations

How has the graph of ***f(x) = x²*** transformed to the graph of $y = f\,o g(x)$?

Explain graphical changes in detail.

<u>Try this!</u>

What do you think the graphical transformation would be for the function $y = (x - 6)^2$ ***?*** Explain your thinking.

What do you think the 2 parent functions are that were composed to form $y = (x - 6)^2$ ***?*** Justify your conjecture.

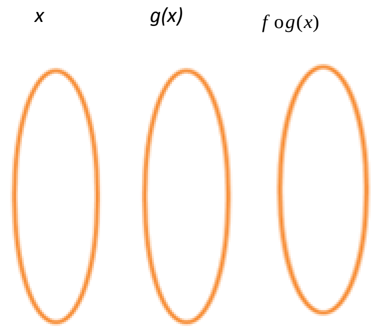
Lesson 24 - Exploring Graphical Transformations and Composite Functions   Date

Consider the functions:

***f(x)* = *x*²** and ***g(x)* = *x* + 3**

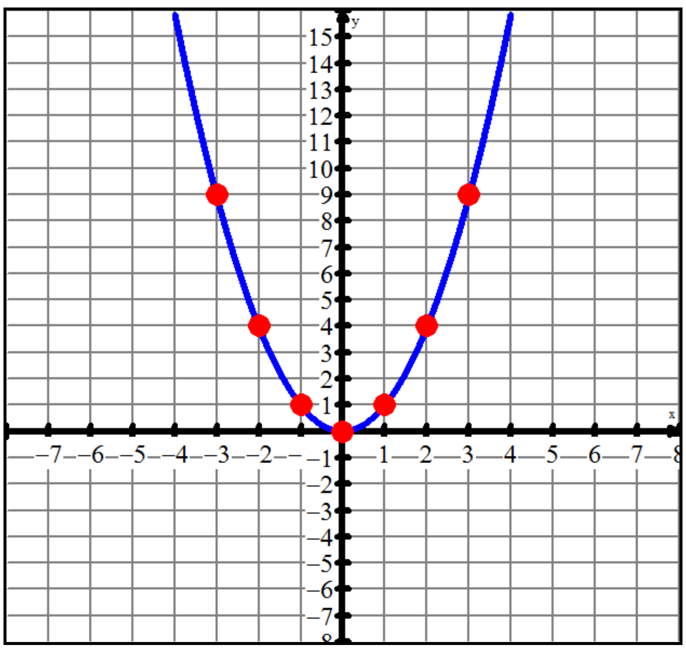
Determine $f \circ g(x)$ = ____________________

Mapping Diagram



Here is the graph of ***f(x)* = *x*²**

Graph the function $y = f \circ g(x)$ using your GDC



Graphical transformations

How has the graph of ***f(x)* = *x*²** transformed to the graph of $y = f \circ g(x)$?

Explain graphical changes in detail.

<u>Try this!</u>

What do you think the graphical transformation would be for the function $y = (x - 6)^2$? Explain your thinking.

What do you think the 2 parent functions are that were composed to form $y = (x - 6)^2$? Justify your conjecture.

Understanding so Far - SUMMARY:

Describe the transformation $y = x^2$ has undergone to form $y = (x + h)^2$.

What are the parent functions that were composed to form $y = (x + h)^2$?

Describe the transformation $y = x^2$ has undergone to form $y = (x)^2 + k$.

What are the parent functions that were composed to form $y = (x)^2 + k$?

Describe the transformation $y = x^2$ has undergone to form $y = (x + h)^2 + k$.

What are the parent functions that were composed to form $y = (x + h)^2 + k$?

(D) Further Compositions

Consider the functions:

f(x) = x^2 and ***g(x) = 3x***

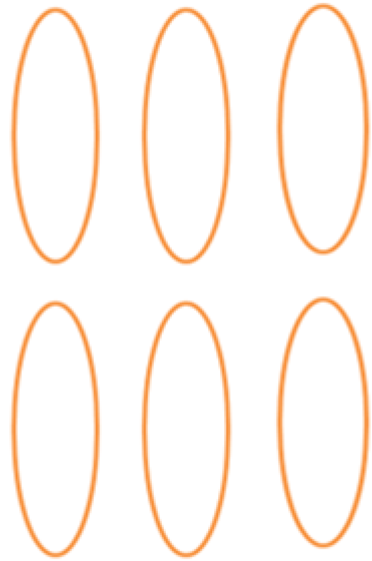
Determine $f \circ g(x)$ = ____________________

$f \circ g(2)$ = ____________________

Determine $g \circ f(x)$ = ____________________

$g \circ f(2)$ = ____________________

Mapping Diagram



Consider the functions:

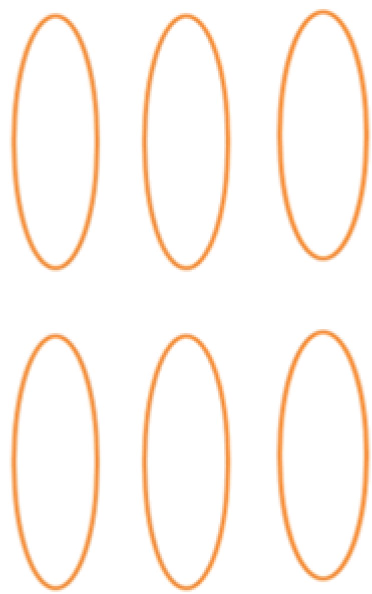
f(x) =x^2 and ***g(x) = -0.25x***

Determine $f \circ g(x)$ = ____________________

$f \circ g(2)$ = ____________________

Determine $g \circ f(x)$ = ____________________

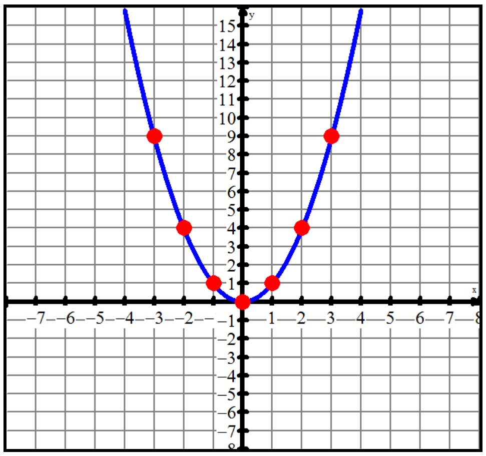
$g \circ f(2)$ = ____________________



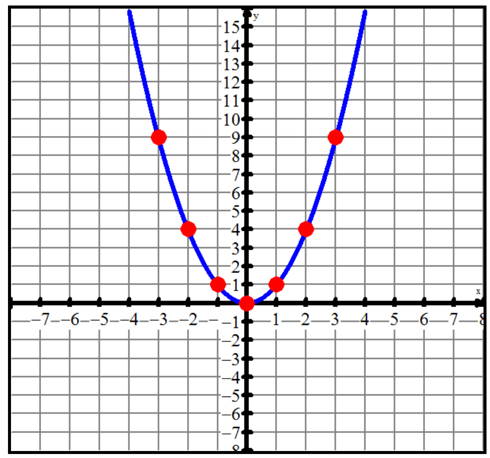
Lesson 24 - Exploring Graphical Transformations and Composite Functions Date

Extension:

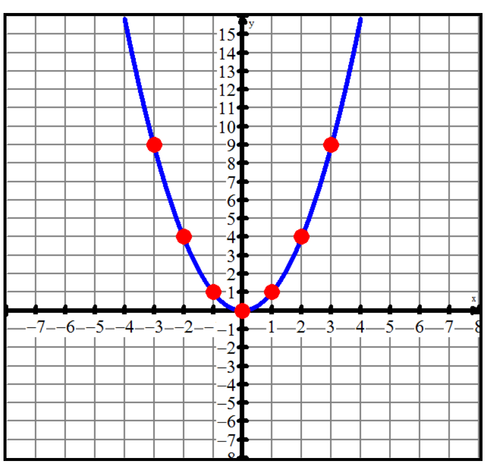
1. For the function $m(x) = 2x^2$ determine the parent functions that are composed to form ***m(x).*** Show this composition in a graph.



2. For the function $r(x) = -\frac{1}{2}x^2$ determine the two parent functions that are composed to form ***r(x).*** Show this composition in a graph.



3. For the function $h(x) = (2x)^2 + 1$ determine the two parent functions that are composed to form $h(x)$. Show this composition in a graph.



4. Describe what transformations the function **p(x)** undergoes to form $y = -1/3(x-2)^2 + 3$. Show this composition in a graph.