PROBLEM 3 Inverse by Composition

You know that when the domain is restricted to $x \geq 0$, the function $f(x) = \sqrt{x}$ is the inverse of the power function $g(x) = x^2$. You also know that the function $h(x) = \sqrt[3]{x}$ is the inverse of the power function $q(x) = x^3$.

The process of evaluating one function inside of another function is called the **composition of functions**. For two functions f and g, the composition of functions uses the output of $g(x)$ as the input of $f(x)$. It is notated as $(f \circ g)(x)$ or $f(g(x))$.

To write a composition of the functions $g(x) = x^2$ and $f(x) = \sqrt{x}$ when the domain of $g(x)$ is restricted to $x \geq 0$, substitute the value of one of the functions for the argument, x, of the other function.

$f(x) = \sqrt{x}$ $\qquad$ $g(x) = x^2$

$$f(g(x)) = \sqrt{x^2} = x, \text{ for } x \geq 0$$

You can write the composition of these two functions as $f(g(x)) = x$ for $x \geq 0$.

1. Determine $g(f(x))$ for the functions $g(x) = x^2$ and $f(x) = \sqrt{x}$ for $x \geq 0$.

If $f(g(x)) = g(f(x)) = x$, then $f(x)$ and $g(x)$ are inverse functions.

2. Are $f(x)$ and $g(x)$ inverse functions? Explain your reasoning.

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3. Algebraically determine whether each pair of functions are inverses. Show your work.

a. Verify that $h(x) = \sqrt[3]{x}$ is the inverse of $q(x) = x^3$.

b. Determine if $k(x) = 2x^2 + 5$ and $j(x) = -2x^2 - 5$ are inverse functions.

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4. Mike said that all linear functions are inverses of themselves because $f(x) = x$ is the inverse of $g(x) = x$.

Is Mike correct? Explain your reasoning.

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