Function Composition

Section 8-7

Function Composition

- Fancy way of denoting and performing SUBSTITUTION
- But first ….
- Let's review.

Function Composition

- Function notation: f(x)
- This DOES NOT MEAN MULITPLICATION.
- Given $f(x) = 3x - 1$, find $f(2)$.
- Substitute 2 for x
- $f(2) = 3(2) - 1 = 6 - 1 = 5$

Function Composition

- Given $g(x) = x^2 - x$, find $g(-3)$

- $g(-3) = (-3)^2 - (-3) = 9 - -3 = 9 + 3 = 12$

- $g(-3) = 12$

Function Composition

- Given $g(x) = 3x - 4x^2 + 2$, find $g(5)$
- $g(5) = 3(5) - 4(5)^2 + 2 =$
- $15 - 4(25) + 2 = 15 - 100 + 2$
- $= -83$
- $g(5) = -83$

Function Composition

- Given $f(x) = x - 5$, find $f(a+1)$
- $f(a + 1) = (a + 1) - 5 = a+1 - 5$
- $]f(a + 1) = a - 4$

Function Composition

- Function Composition is just fancy substitution, very similar to what we have been doing with finding the value of a function.
- The difference is we will be plugging in another function

Function Composition

- Just the same we will still be replacing x with whatever we have in the parentheses.
- The notation looks like $f(g(x))$.
- We read it ‘f of g of x’

Function Composition

- The book uses $[f \circ g](x)$ for $f(g(x))$ and $[g \circ f](x)$ for $g(f(x))$.
- Our notation is easier to understand & is used on the SOL.
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Function Composition

- EXAMPLE
- Given $f(x) = 2x + 2$ and $g(x) = 2$, find $f(g(x))$.
- Start on the inside. $f(g(x))$
- $g(x) = 2$, so replace it.
- $f(g(x)) = f(2) = 2(2) + 2 = 6$

Function Composition

- Given $g(x) = x - 5$ and $f(x) = x + 1$, find $f(g(x))$.
- $g(x) = x - 5$ so replace it.
- $f(g(x)) = f(x - 5)$
- Now replace x with $x - 5$ in $f(x)$.

Function Composition

- $f(x - 5) = (x - 5) + 1 =$
  $x - 5 + 1 = x - 4$
- So $f(g(x)) = x - 4$.

Function Composition

- Given $f(x) = x^2 + x$ and $g(x) = x - 4$, find $f(g(x))$
- $f(g(x)) = f(x - 4) = (x - 4)^2 + (x - 4) = x^2 - 8x+16+x - 4 = x^2 - 7x+12$
- $f(g(x)) = x^2 - 7x + 12$

Function Composition

- Given $f(x) = x^2 + x$ and $g(x) = x - 4$, $g(f(x))$.
- $g(f(x)) = g(x^2 + x) = x^2 + x - 4$

Function Composition

- Given $f(x) = 2x + 5$ and $g(x) = 8 + x$, find $f(g(-5))$.
- Start in the middle:
  $g(-5) = 8 + -5 = 3$.
- So replace $g(-5)$ with 3 and we get $f(3) = 2(3) + 5 = 6 + 5 = 11$

Function Composition

- Given $f(x) = 2x + 5$ and $g(x) = 8 + x$, find $g(f(-5))$.
- Start in the middle: $f(-5) = 2(-5) + 5 = -10 + 5 = -5$
- Replace $f(-5)$ with -5 and we have $g(-5) = 8 + -5 = 3$.
- $g(f(-5)) = 3$

Function Composition

Any Questions?

Function Inverse

- Quick review.
- {(2, 3), (5, 0), (-2, 4), (3, 3)}
- Domain & Range = ?
- Inverse = ?
- D = {2, 5, -2, 3}
- R = {3, 0, 4}

Function Inverse

- {(2, 3), (5, 0), (-2, 4), (3, 3)}
- Inverse = switch the x and y, (domain and range)
- I = {(3, 2), (0, 5), (4, -2), (3, 3)}

Function Inverse

- {(4, 7), (1, 4), (9, 11), (-2, -1)}
- Inverse = ?
- I = {(7, 4), (4, 1), (11, 9), (-1, -2)}

Function Inverse

- Now that we can find the inverse of a relation, let's talk about finding the inverse of a function.
- What is a function?
- a relation in which no member of the domain is repeated.

Function Inverse

- To find the inverse of a function we will still switch the domain and range, but there is a little twist …
- We will be working with the equation.

Function Inverse

- So what letter represents the domain?
- x
- So what letter represents the range?
- y

Function Inverse

- So we will switch the x and y in the equation and then resolve it for …
- y.

Function Inverse

- Find the inverse of the function $f(x) = x + 5$.
- Substitute y for f(x). $y = x + 5$.
- Switch x and y. $x = y + 5$
- Solve for y. $x - 5 = y$

Function Inverse

- So the inverse of $f(x) = x + 5$ is $y = x - 5$ or $f^{-1}(x) = x - 5$.

Function Inverse

- Given $f(x) = 3x - 4$, find its inverse ($f^{-1}(x)$).
- $y = 3x - 4$
- switch. $x = 3y - 4$
- solve for y. $x + 4 = 3y$
- $y = (x + 4)/3$

Function Inverse

- Given $h(x) = -3x + 9$, find it's inverse.
- $y = -3x + 9$
- $x = -3y + 9$
- $x - 9 = -3y$
- $(x - 9) / -3 = y$

Function Inverse

- Given

$$f(x) = \frac{2x + 5}{3}$$

- Find the inverse.

Function Inverse

$$y = \frac{2x + 5}{3}$$

$$x = \frac{2y + 5}{3}$$

Function Inverse

- $3x = 2y + 5$
- $3x - 5 = 2y$

$$\frac{3x - 5}{2} = y$$

Function Inverse

- Given $f(x) = x^2 - 4$
- $y = x^2 - 4$
- $x = y^2 - 4$
- $x + 4 = y^2$
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Function Inverse

- $x + 4 = y^2$

$$\sqrt{y^2} = \sqrt{x + 4}$$

$$y = \pm\sqrt{x + 4}$$

Function Inverse

Any Questions?

Function Inverse

- Assignment
- Page 29 #12, 17, 22, 27, 35, 40
- Page 220 #5, 7, 9, 11