Composite Functions

Students will be able to form composite functions and decompose functions.

Precalculus 11: Functions

Honors Precalculus/ Precalculus

Identifying the Domain of a Function

The domain of any function is the set of all real numbers unless the function includes:

- Division with a variable
- Finding the even root of a variable $\sqrt{x}, \sqrt[4]{x}, \sqrt[8]{x}$ etc $(x)^{\frac{1}{4}}$

Example 1: Find the domain of each function.

a) $f(x) = 3x^2 - 2x$

Domain: $(-\infty, \infty)$

b) $f(x) = \frac{2x}{x^2-x-6}$

$(x-3)(x+2)$ so $x \neq 3, -2$

D: $(-\infty, -2) \cup (-2, 3) \cup (3, \infty)$

c) $f(x) = \sqrt{x-9}$

$x - 9 \geq 0$

$x \geq 9$

D: $[9, \infty)$

d) $\frac{2x}{\sqrt{x-9}}$

$x - 9 > 0$ D: $(9, \infty)$

$x > 9$

e) $\frac{\sqrt{x-4}}{x^2-25}$

N

$x - 4 \geq 0$

$x \geq 4$

D: $[4, \infty)$

D

$x^2 - 25 = 0$

$x^2 = 25$

$x = \pm 5$

D: $(-\infty, -5) \cup (-5, 5) \cup (5, \infty)$

D: $[4, \infty)$ $x \neq 5$

$[4, 5) \cup (5, \infty)$

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Composite Functions

A composite function is the result of substituting one function for the variable of another functn.

Example 2: find the composition of the function f with g and the composition of the function g with f. Then the composition of j with k and the composition of k with j.

$f(x) = x + 5$ $\quad g(x) = 10x^2 + 3x + 1$

Substituting g into f

a) $(f \circ g)$= f(g(x)) $= (10x^2 + 3x + 1) + 5$

$= 10x^2 + 3x + 6$

Domain

$D_{f(x)}: (-\infty, \infty)$ $\quad D: (-\infty, \infty)$

$D_{g(x)}: (-\infty, \infty)$

Subst. f into g

b) $(g \circ f)$= g(f(x)) $10(x+5)^2 + 3(x+5) + 1$

$10(x^2 + 10x + 25) + 3(x+5) + 1$

$10x^2 + 100x + 250 + 3x + 15 + 1$

$10x^2 + 103x + 266$

Domain

$D: (-\infty, \infty)$

$j(x) = \frac{5x}{x}$ $\quad k(x) = \frac{10}{6x}$

$D_{j+k}: (-\infty, \infty)\ x \neq 0$

k into j ← c. $(j \circ k)$= j(k(x)) $\quad$ j into k d. $(k \circ j)$= k(j(x))

$$\frac{5\left(\frac{10}{6x}\right)}{\frac{10}{6x}} \qquad \frac{10}{6\left(\frac{5x}{x}\right)} = \frac{10}{30x} = \frac{10}{30} = \frac{1}{3}$$

$$\frac{\frac{50}{6x}}{\frac{10}{6x}}$$

$$\frac{50}{6x} \cdot \frac{6x}{10}$$

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Example 3: **find the composition of the function f with g and the composition of the function g with f.**

$f(x) = 4x$ D: $(-\infty, \infty)$ $\quad g(x) = \frac{3}{x+2}$ D: $(-\infty,-2)\cup(-2,\infty)$

g into f

a) $(f \circ g)$= f(g(x)) $\quad \frac{4}{1}\left(\frac{3}{x+2}\right) = \frac{12}{x+2}$ D: $(-\infty,\infty)$ $x \neq -2$

f into g

b) $(g \circ f)$= g(f(x)) $\quad \frac{3}{4x+2}$ $\quad 4x+2=0$, $x=-\frac{1}{2}$, $x \neq -\frac{1}{2}$

D: $(-\infty,\infty)$ $x \neq -2, \text{or} -\frac{1}{2}$

c) g(f(1)) $\quad \frac{3}{4(1)+2} = \frac{3}{6} = \frac{1}{2}$

d) f(g(4)) $\quad \frac{12}{4+2} = 2$

Example 4:

A consumer advocacy company conducted a study to research the pricing of fruits and vegetables. They collected data on the size and price of produce items, including navel oranges. They found that, for a given chain of stores, the price of oranges was a function of the weight of the oranges, $p = f(w)$.

w weight in pounds	0.2	0.25	0.3	0.4	0.5	0.6	0.7
p price in dollars	0.26	0.32	0.39	0.52	0.65	0.78	0.91

The company also determined that the weight of the oranges measured was a function of the radius of the oranges, $w = g(r)$.

r radius in inches	1.5	1.65	1.7	1.9	2	2.1
w weight in pounds	0.38	0.42	0.43	0.48	0.5	0.53

Use the table to evaluate $f(g(2))$ $= 0.65$

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Decomposing Functions

Decomposing a function means reversing a composite, Identify f(x) and g(x). Think of g(x) as the inside function and f(x) is the outside function.

Example 4: Decompose the function. $h(x) = f(g(x))$

a) $h(x) = (3x - 5)^2$

$g(x) = 3x - 5$ $g(x) = 3x$ $g(x) \neq f(x)$

$f(x) = x^2$ $f(x) = (x-5)^2$

b) $h(x) = \frac{5}{\sqrt{x+12}}$

$g(x) = x+12$ or $g(x) = \sqrt{x+12}$ or $g(x) = \frac{5}{\sqrt{x+12}}$

$f(x) = \frac{5}{\sqrt{x}}$ $f(x) = \frac{5}{x}$ $f(x) = x$

c) $h(x) = \sqrt[3]{x^2 - 8}$

$g(x) = x^2 - 8$

$f(x) = \sqrt[3]{x}$