Composite Functions *Students will be able to form composite functions and decompose functions.* *Precalculus 11: Functions*	Honors Precalculus/ Precalculus KEY

Identifying the Domain of a Function

The domain of any function is the set of all real numbers unless the function includes: $\mathbb{R}$

- Division with a variable $\frac{\quad}{x} \to \neq 0$ No "0" in denominator
- Finding the even root of a variable $\sqrt{x} \geq 0$ No negative $\sqrt{\ }$

Example 1: Find the domain of each function.

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

Domain: $\mathbb{R}$, all reals, $(-\infty, \infty)$

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

Domain: $\mathbb{R}$, $x \neq -2$, $x \neq 3$

$x^2 - x - 6 \neq 0$

$(x+2)(x-3) \neq 0$

$x \neq -2$, $x \neq 3$

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

Domain: $[9, \infty)$

$x - 9 \geq 0$

$x \geq 9$

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

Domain: $(9, \infty)$

$x - 9 > 0$

$x > 9$

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

$x - 4 \geq 0$ $\quad x^2 - 25 \neq 0$

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

$x \geq 4$ $\quad x^2 \neq 25$

$x \neq \pm 5$

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.

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

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

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

Domain : $\mathbb{R}$

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

$= 10(x^2+10x+25)+3x+15+1$

$= 10x^2+100x+250+3x+16$

$= 10x^2+103x+266$

$(x+5)(x+5)$

$x^2+10x+25$

Domain

$\mathbb{R}$

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

c. $(j \circ k)$= j(k(x))

$= \dfrac{5\left(\cancel{\frac{10}{6x}}\right)}{\left(\cancel{\frac{10}{6x}}\right)} = 5$

d. $(k \circ j)$= k(j(x))

$= \dfrac{10}{6\left(\frac{5\cancel{x}}{\cancel{x}}\right)}$

$= \dfrac{10}{30} = \dfrac{1}{3}$

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

$$f(x) = 4x \qquad g(x) = \frac{3}{x+2}$$

a) $(f \circ g) = f(g(x)) = 4\left(\frac{3}{x+2}\right) = \frac{12}{x+2}$

b) $(g \circ f) = g(f(x)) = \frac{3}{(4x)+2} = \frac{3}{4x+2}$

c) $g(f(1))$ $f(1) = 4(1) = 4$

$g(4) = \frac{3}{4+2} = \frac{3}{6} = \boxed{\frac{1}{2}}$

d) $f(g(4))$ $g(4) = \frac{1}{2}$ $f(\frac{1}{2}) = 4(\frac{1}{2}) = \frac{4}{2} = \boxed{2}$

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 $f(g(2))$

$g(2) = 0.5$

$f(0.5) = 0.65$

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.

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

$f(x) = x^2$ $\quad$ $g(x) = 3x - 5$

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

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

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

$f(x) = \sqrt[3]{x}$ $\quad$ $g(x) = x^2 - 8$