

Composition of Functions Analytically

Let  $f$  and  $g$  be functions of  $x$ . The composition of  $(f \circ g)(x)$  is defined by

$$f(g(x))$$

**Let**  $f(x) = x^2 - 1$  and  $g(x) = 3x$

1. Find.  $(f \circ g)(x)$   
 $f(g(x)) \rightarrow f(3x)$

$$(3x)^2 - 1 = \boxed{9x^2 - 1}$$

2. Find.  $(g \circ f)(x)$   
 $g(f(x)) \rightarrow g(x^2 - 1)$

$$3(x^2 - 1) = \boxed{3x^2 - 3}$$

**Let**  $f(x) = \frac{x}{x+1}$  and  $g(x) = 2x+3$

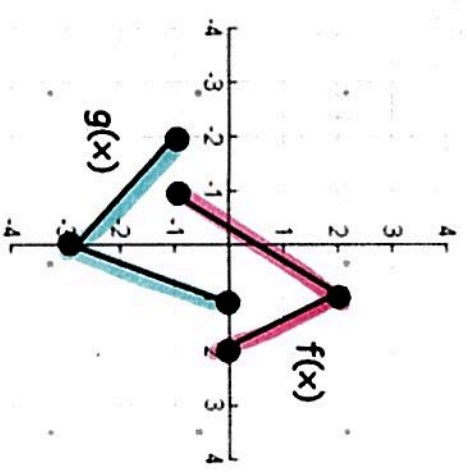
3. Find.  $(f \circ g)(x)$   
 $f(g(x)) \rightarrow f(2x+3) = \frac{2x+3}{2x+3+1}$

4. Find.  $(g \circ f)(x)$   
 $g(f(x)) \rightarrow g\left(\frac{x}{x+1}\right) = 2\left(\frac{x}{x+1}\right) + 3 = \frac{2x}{x+1} + 3$

Composition of Functions Graphically

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5. Use the graphs of  $f(x)$  and  $g(x)$  to find the following:



a)  $(f \circ g)(-2) \rightarrow f(-1) = \boxed{-1}$

$f(g(-2)) \rightarrow f(-1) = \boxed{-1}$

b)  $(g \circ f)(-1) \rightarrow g(2) = \boxed{-2}$

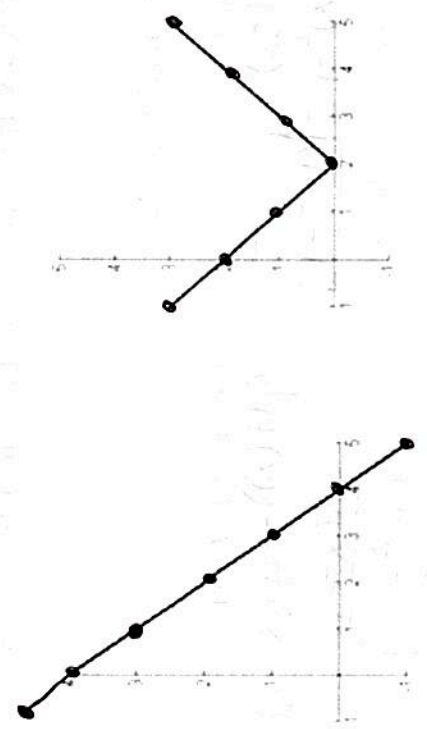
$g(f(-1)) \rightarrow g(2) = \boxed{-2}$

c)  $(g \circ g)(1) \rightarrow g(0) = \boxed{-3}$

$g(g(1)) \rightarrow g(0) = \boxed{-3}$

## Composition of Functions Application

6. Use the graphs of  $f(x)$  and  $g(x)$  to evaluate functions.



$f(x)$

$g(x)$

a)  $(f \circ g)(1)$

$f(g(1)) \rightarrow f(1) = \boxed{2}$

b)  $(g \circ f)(3)$

$g(f(3)) \rightarrow g(4) = \boxed{1}$

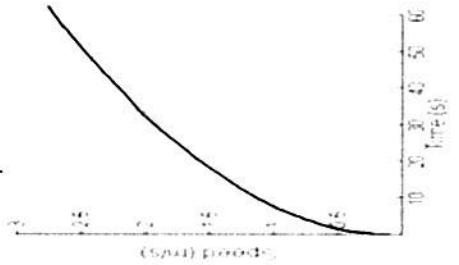
c)  $(f \circ g)(0)$

$f(g(0)) \rightarrow f(3) = \boxed{4}$

d)  $(g \circ f)(-1)$

$g(f(-1)) \rightarrow g(2) = \boxed{3}$

Speed vs. Time

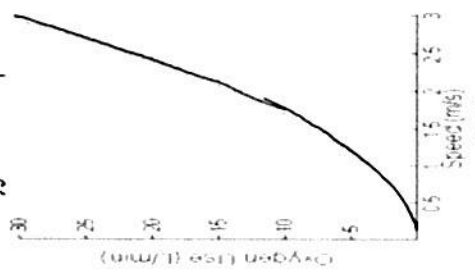


A

a) Graph A shows a jogger's speed with respect to time. According to this graph, after jogging for 10 seconds, how fast was the jogger running?

about 1.1 m/s

Oxygen Use vs. Speed



B

c) After jogging for 40 seconds, approximately how much oxygen did the jogger use?

about 17 l/min

d) How much oxygen did the jogger use after 55 seconds?

about 23 l/min

e) If the jogger used oxygen at a rate of 7.5 l/min, how long had the jogger been running?

about 18 sec

b) Graph B shows the jogger's oxygen consumption with respect to his/her speed. According to this graph, how much oxygen would a jogger jogging 1 m/sec use?

about 4 l/min