

Function Composition and Inverses: math practice, Grade 12 – download the PDF

24 problems graded by difficulty (★ easy, ★★ medium, ★★★ hard). Try first, without looking at the solutions!

1 Evaluating composites

★ ★ ★

Let $f(x) = 2x + 5$ and $g(x) = x^2 - 3$. Compute $(f \circ g)(3)$, $(g \circ f)(3)$ and $(f \circ f)(-1)$.

2 Building composite formulas

★ ★ ★

Let $f(x) = x - 7$ and $g(x) = 4x$. Find $(f \circ g)(x)$ and $(g \circ f)(x)$. Are they equal?

3 A simple domain

★ ★ ★

Let $f(x) = \sqrt{x}$ and $g(x) = x + 6$. Find $(f \circ g)(x)$ and $(g \circ f)(x)$, and give the domain of each.

4 Horizontal line test

★ ★ ★

Decide which of these functions are one-to-one, and justify with the horizontal line test:

$f(x) = 2x - 9$, $g(x) = x^2$, $h(x) = x^3 + 1$, $k(x) = |x|$, $m(x) = \frac{1}{x}$.

5 A linear inverse



Find the inverse of $f(x) = 5x - 8$, then check your answer with the input 7.

6 Even, odd or neither



Classify each function as even, odd, or neither: $f(x) = x^6 - 2x^2$, $g(x) = 4x^3 + x$, $h(x) = x^2 + 3x$.

7 Absolute values and pieces



(a) Solve $|x + 4| = 9$.

(b) Let $q(x) = 3x - 1$ if $x \leq 2$, and $q(x) = x^2 - 1$ if $x > 2$. Find $q(-2)$, $q(2)$ and $q(4)$.

8 Payroll at a repair shop



A phone repair shop schedules $h(d) = 6d$ work hours over d days. A technician earns $P(h) = 22h + 15$ dollars for h hours (including a \$15 bonus). Find $P(h(d))$ and use it to find the pay for 5 days.

9 A hidden restriction



Let $f(x) = \frac{1}{x-2}$ and $g(x) = x + 5$. Write $(f \circ g)(x)$ and find its domain.

10 Inverse of a rational function



Find the inverse of $f(x) = \frac{4x-1}{x+3}$ ($x \neq -3$) and verify it with the input 0.

11 A cubic inverse



Show that $f(x) = 2x^3 - 16$ is one-to-one on the real numbers and find f^{-1} .

12 Are they inverses?

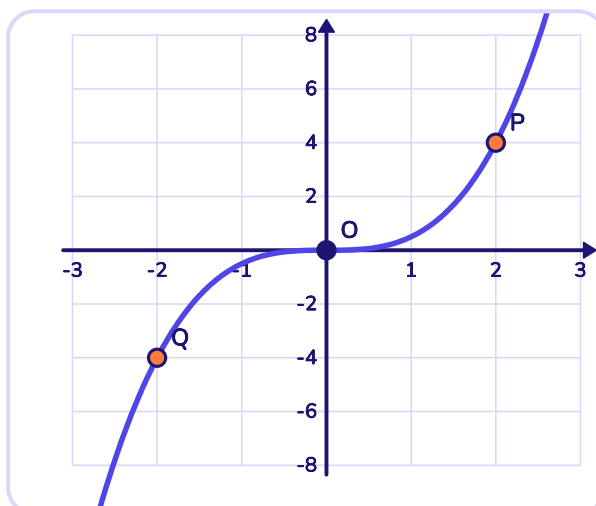


Show by composition that $f(x) = 2x + 3$ and $g(x) = \frac{x-3}{2}$ are inverses of each other.

13 Reading a graph and its inverse



The graph of the one-to-one function $f(x) = \frac{x^3}{2}$ is shown below.



(a) Use the points P and Q to find $f^{-1}(4)$ and $f^{-1}(-4)$. (b) Give the coordinates of the two points of the graph of f^{-1} that correspond to P and Q . (c) Find a formula for f^{-1} .

14 Describing a transformation



Describe how the graph of $g(x) = -|x - 3| + 5$ is obtained from $y = |x|$, then give its vertex, its y-intercept, and its x-intercepts.

15 Symmetry proofs

Prove that $f(x) = \frac{x}{x^2 + 1}$ is odd and that $g(x) = |x| + x^2$ is even. Then show that $h(x) = x^3 + x^2$ is neither.

16 Absolute value as pieces

(a) Rewrite $|3 - 2x|$ as a piecewise function. (b) Solve $|3 - 2x| = 7$.

17 Converting temperatures

The Fahrenheit temperature is $F(C) = \frac{9}{5}C + 32$, where C is in degrees Celsius. (a) Find the inverse function. (b) A thermometer reads 98.6°F . What is that in Celsius? (c) Explain what F^{-1} represents.

18 Domain traps with a root

Let $h(x) = \sqrt{x^2 - 9}$. (a) Decompose $h = f \circ g$. (b) Find the domain of h . (c) With your f and g , find $(g \circ f)(x)$ and its domain, and explain why it differs from the domain of h .

19 Both orders, both domains

Let $f(x) = \sqrt{4 - x}$ and $g(x) = x^2$. Find $f \circ g$ and $g \circ f$ with their domains.

20 Inverse after restriction

Let $f(x) = x^2 + 6x + 1$ for $x \geq -3$. (a) Complete the square and give the range of f . (b) Find f^{-1} with its domain and range. (c) Verify that $(-1, -4)$ is on the graph of f and $(-4, -1)$ is on the graph of f^{-1} . (d) What would f^{-1} be if the domain were $x \leq -3$?

21 Inverse of a piecewise function



Let $f(x) = x + 4$ if $x \leq 0$, and $f(x) = 2x + 6$ if $x > 0$. (a) Find the range of each piece and explain why f is one-to-one. (b) Find f^{-1} as a piecewise function with its domain. (c) Verify with $f(-3)$ and $f(2)$.

22 Solving with composition



Let $f(x) = x^2 - 1$ and $g(x) = 2x + 3$. (a) Solve $(f \circ g)(x) = 24$. (b) Solve $(g \circ f)(x) = x$.

23 Moving points under a transformation



The points $(-2, 3)$, $(0, -1)$ and $(4, 5)$ lie on the graph of $y = f(x)$. Find the images of these points on the graph of (a) $y = -2f(x - 1) + 3$ and (b) $y = \frac{1}{2}f(-x)$.

24 Parity of composites



Let f and g be defined on all real numbers. Prove: (a) if f is odd and g is even, then $f \circ g$ is even; (b) if f and g are both odd, then $f \circ g$ is odd. Then illustrate (a) with $f(x) = x^3$ and $g(x) = x^2 + 1$.



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