MATH 161 — Precalculus[1]
Community College of Philadelphia

Joanne Darken
Martin Ligare

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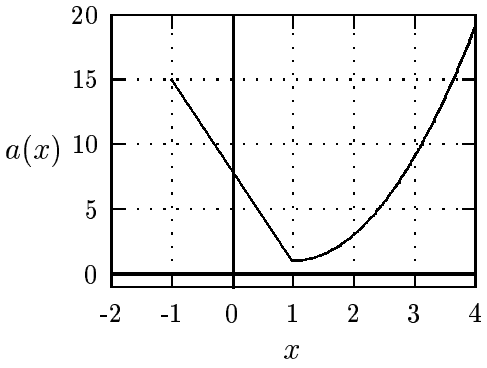
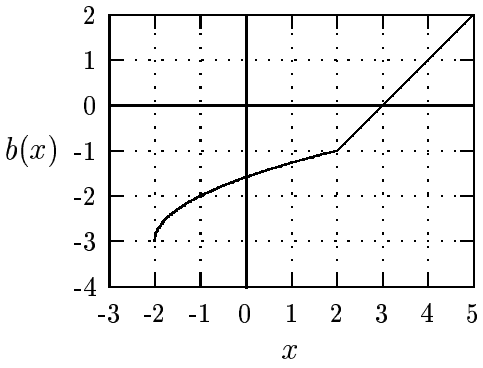
Math 161 — Chapter 6
Class Exercises

For Problems 1 and 3 consider the five functions f, g, h, a, and b; three of which are given by the algebraic formulas

- $f(x) = x^2$
- $g(x) = x - 9$
- $h(x) = \sqrt{x}$

and two of which are illustrated in the graphs below.





1. Using the functions defined above, evaluate the following expressions.

   (a) $(f + g)(2)$
   (b) $(f - a)(0)$
   (c) $(h \cdot b)(1)$
   (d) $(a - b)(-1)$
   (e) $(b + h - a)(4)$
   (f) $(g \div h)(25)$

2. Let $f(x) = x^2 - x$, $g(x) = 3x - 1$, $h(x) = \frac{x}{3}$. Find:

   (a) $(f + g)(4)$
   (b) $(f - g)(2)$
   (c) $(hg)(3)$

(d) $(f/h)(-6)$
(e) $(f+g)(t)$
(f) $(f-g)(4m)$
(g) $(hf)(2x+5)$
(h) $(f+g-h)(9)$
(i) $(f+2g)(-1)$
(j) $(3g-2f)(1)$
(k) $(fg)(t)$
(l) $(h/g)(6t-15)$

3. Using the functions defined above Exercise 1, construct the indicated compositions, where possible. If not possible, explain what the trouble is.

(a) $g \circ f(6)$
(b) $f \circ g(6)$
(c) $g \circ f(x)$
(d) $f \circ g(x)$
(e) $a \circ b(3)$
(f) $f \circ b(-1)$
(g) $a \circ h(9)$
(h) $h \circ g(13)$
(i) $h \circ g(8)$
(j) $a \circ b(-1)$
(k) $a \circ g(10)$

4. Using the functions defined in Exercise 2, construct the indicated compositions, where possible. If not possible, explain what the trouble is.

(a) $g \circ f(1)$
(b) $f \circ g(6)$
(c) $g \circ f(x)$
(d) $f \circ g(x)$

(e) $h \circ f(3)$
(f) $f \circ f(-1)$
(g) $f \circ h(3)$
(h) $h \circ g(13)$
(i) $g \circ h(8)$
(j) $h \circ h \circ h(-1)$
(k) $f \circ g(t)$
(l) $g \circ f(2x)$
(m) $f \circ g(-t)$
(n) $g \circ f(x-1)$
(o) $f \circ g(x+2)$
(p) $h \circ f \circ h(3)$
(q) $f \circ f(-x)$
(r) $f \circ h(3t)$
(s) $h \circ g(\frac{1}{3})$
(t) $g \circ h(0)$
(u) $g \circ g \circ g(x)$
(v) $f \circ g(t)$

5. For each function h given, find two functions f and g such that h is the composition $g \circ f$. When doing decomposition problems, it is important to define the simpler functions clearly, and to state the order in which they appear.

(a) $h(x) = |x+7|$
(b) $h(x) = \sqrt{x+2}$
(c) $h(x) = x^2 - 11$
(d) $h(x) = 5x + 93$
(e) $h(x) = \frac{x-47}{11}$
(f) $h(x) = x^3 - 43$
(g) $h(x) = 5\sqrt{x}$
(h) $h(x) = (x-3)^2 + 7(x-3) - 9$
(i) $h(x) = (x+3)^4 - 5(x+3)^3 + 2(x+3)^2 - 1$
(j) $h(x) = 5(x-3)^3 + 10(x-3)^2 - 7(x-3) + 2$

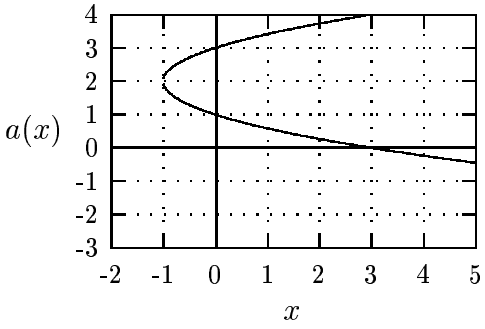
6. For each of the graphs below answer the following questions:

   (a) Is this the graph of a function?

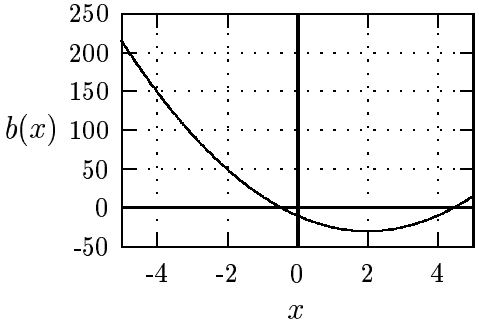
   (b) If the graph represents a function, is it one-to-one?

   (c) If the function is not one-to-one, give a restricted domain for which the function is one-to-one.

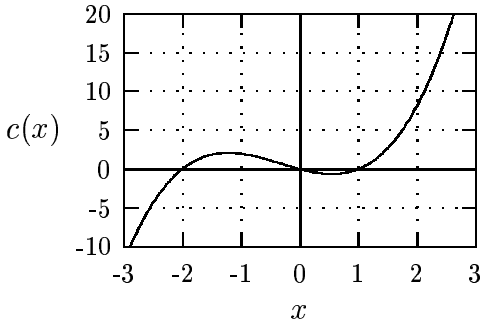
Problem 6, Graph A



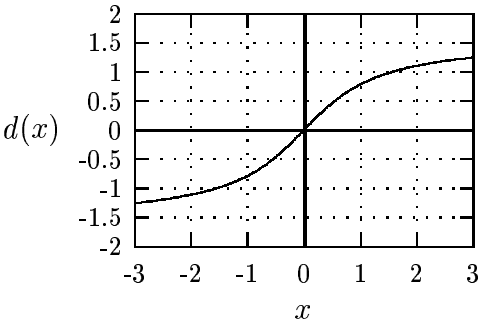
Problem 6, Graph B



Problem 6, Graph C



Problem 6, Graph D

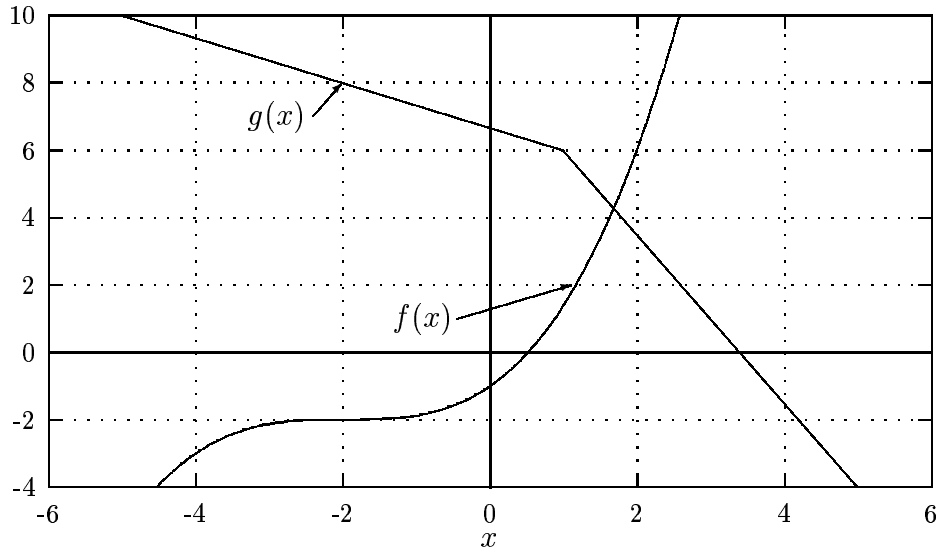


7. For each of the following functions, answer the following questions:

   - Is the function one-to-one?
   - If the function is one-to-one, find its inverse. If not, give a restricted domain on which it is one-to-one, and give its inverse on that domain.
   - Give the domain and range of each function.
   - Give the domain and range of the inverse of each function.

   (a) $f(x) = 7x - 9$
   (b) $g(x) = x^2$
   (c) $h(x) = |x - 3|$
   (d) $J(x) = x^3$
   (e) $k(x) = 3x^4$
   (f) $M(x) = 1/x$
   (g) $n(x) = 3/(x - 1)$
   (h) $P(x) = \sqrt{x}$
   (i) $f(x) = 3x + 5$
   (j) $g(x) = x^2 - 1$
   (k) $h(x) = 3|x + 2|$
   (l) $J(x) = x^2 - x$
   (m) $k(x) = x^2 - 2x + 1$
   (n) $M(x) = \frac{2}{x}$
   (o) $n(x) = 3/(x - 1)$
   (p) $P(x) = \sqrt{x + 5}$

8. Two functions, $f(x)$ and $g(x)$, are plotted below.



Estimate values for the following inverses:

(a) $g^{-1}(6)$

(b) $f^{-1}(6)$

(c) $g^{-1}(0)$

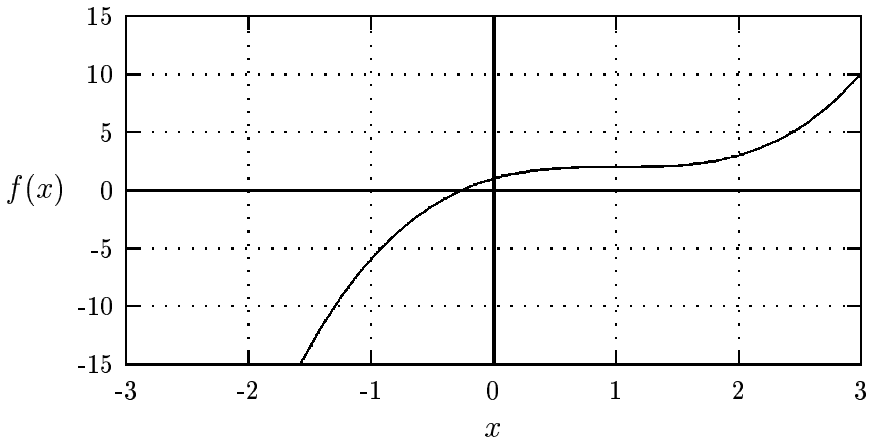
(d) $f^{-1}(0)$

(e) $g^{-1}(8)$

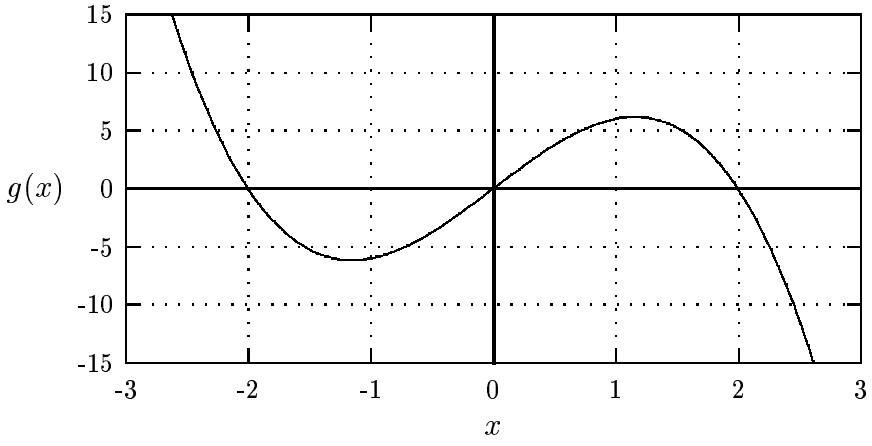
(f) $f^{-1}(-2)$

9. The graphs below are illustrations of a cubic function $f(x)$, a cubic function $g(x)$, and a quadratic function $h(x)$.

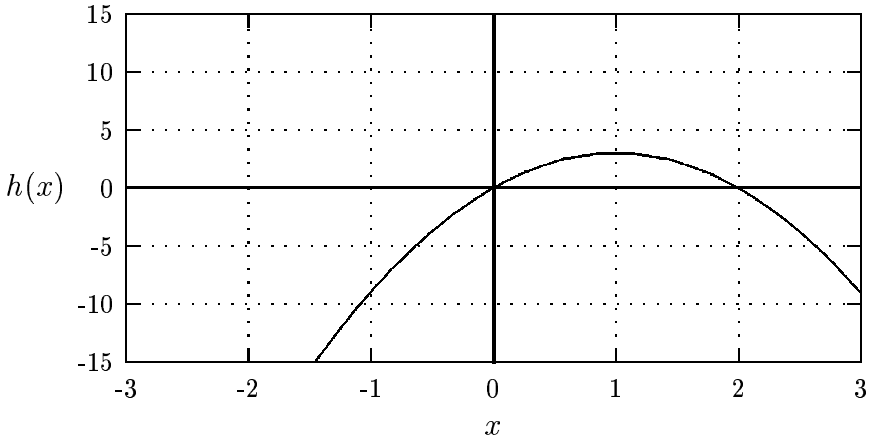
Problem 9: $f(x)$



Problem 9: $g(x)$



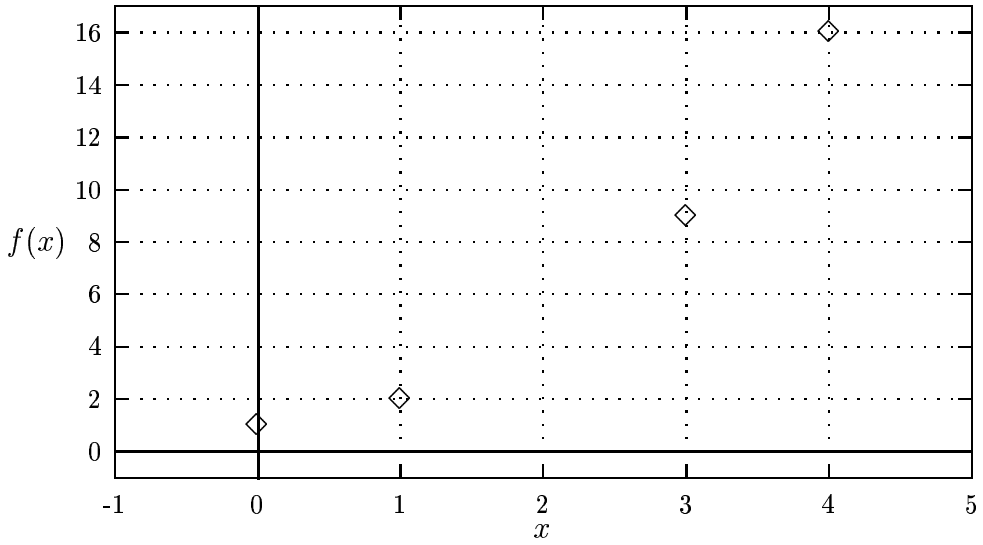
Problem 9: $h(x)$

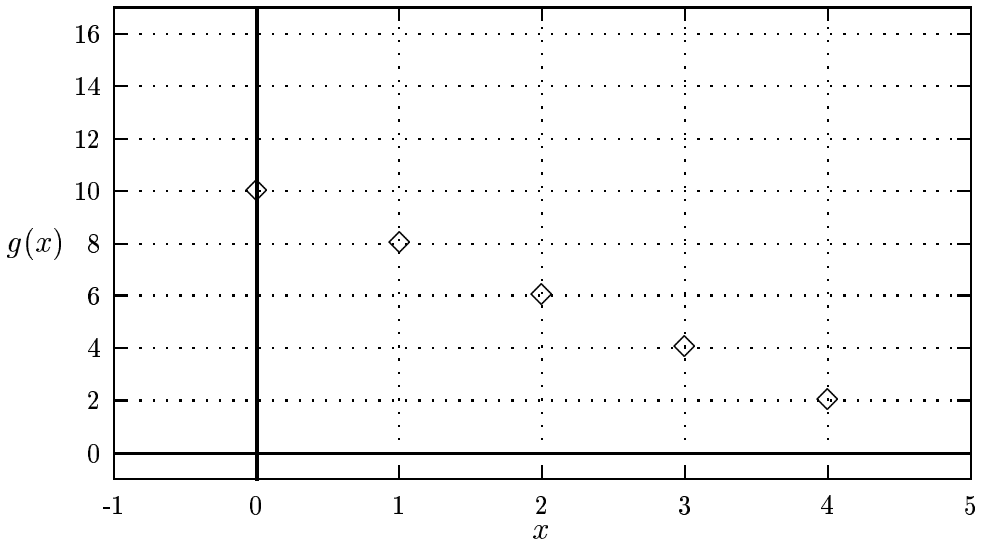


If possible, estimate the following inverses from the graphs. If not possible, explain the trouble.

(a) $f^{-1}(10)$
(b) $f^{-1}(5)$
(c) $f^{-1}(-5)$
(d) $f^{-1}(-10)$
(e) $g^{-1}(10)$
(f) $g^{-1}(-10)$
(g) $g^{-1}(0)$
(h) $h^{-1}(10)$
(i) $h^{-1}(0)$

10. Each graph gives a function (a "baby function"). Copy the graph of each function onto a coordinate system of your own, and graph the inverse of each function. Use equal scales on the two axes, and label both the function and its inverse clearly.





11. On each coordinate system in the exercise above, draw in the line $y = x$. This line has a special relationship to the functions and their inverses. What is it?

12. Find the inverse of each of the following functions:

    (a) $f(x) = 3x + 4$

    (b) $g(x) = 7x - 6$

    (c) $h(x) = x^2$ (Assume $x > 0$)

    (d) $F(x) = x^2 - x$ (Assume $x > 1$)

    (e) $G(x) = x^3$

    (f) $H(x) = x/2$

    (g) $f(x) = \frac{x-5}{3}$

    (h) $P(x) = x^4$ (Assume $x > 0$)

    (i) $Q(x) = |x|$ (Assume $x < 0$)

    (j) $R(x) = x^2 + 5$ What assumption about x must you make?

    (k) $T(x) = |x - 5|$ What assumption about x must you make?

    (l) $W(x) = x^5 + 1$ What assumption about x must you make?

    (m) $F(x) = 7x^6$ What assumption about x must you make?

(n) $g(x) = 3x^{1/2} - 11$ What assumption about x must you make?

(o) $f(x) = 4x^{2/3}$ What assumption about x must you make?

(p) $F(x) = 2x^{4/5} - 9$ What assumption about x must you make?

(q) $H(x) = \frac{9}{x^{5/2}}$ What assumption about x must you make?