(1) Verify that the following are pairs of inverse functions:
   (a) \( f(x) = 3x - \frac{1}{2}, \ g(x) = \frac{2y + 1}{2} \)
   (b) \( f(x) = \sqrt{x + 5}, \ g(x) = \frac{6}{x^3 - 5} \)
   (c) \( g(x) = \frac{3x - 2}{2x + 3}, \ h(x) = -\frac{3x + 2}{2y - 3} \)
   (d) \( h(x) = x^2 - 3 \) with domain \([0, \infty)\), \( g(x) = \sqrt{x + 3} \)
   (e) \( f(x) = 2 - \sqrt{x + 7}, \ h(x) = x^2 - 4x - 3 \) with domain \((-\infty, 2] \)
   (f) \( f(x) = \log_{10}(3x - 5), \ g(x) = \frac{10^x + 5}{3} \)

(2) Are the functions \( f(x) = x^2 \) and \( g(x) = \sqrt{x} \) inverses?

(3) A function is called an **involution** if it is its own inverse. In other words, a function \( f \) is an involution if for all \( x \) in the domain of \( f \), we have that \( (f \circ f)(x) = x \). Show that the following functions are involutions:
   (a) \( f(x) = \frac{1}{x} \)
   (b) \( g(x) = \sqrt{16 - x^2} \) with domain \([0, 4]\)
   (c) \( f(x) = \frac{2x - 3}{4x - 2} \)

(4) **Extra Credit** Is the function \( f(x) = \sqrt{16 - x^2} \) with domain \([-4, 0]\) an involution? Justify your answer.

(5) **Extra Credit** Is it possible to restrict the domain of the function \( f(x) = 42 \) so that it becomes an involution?

(6) For the following pair of functions determine the compositions \( f \circ g \) and \( g \circ f \). In each case you should give the domain as well as the formula.
   (a) \( f(x) = 3x - 1, \ g(x) = 2x + 3 \)
   (b) \( f(x) = x - 2, \ g(x) = 5x^2 - 2 \)
   (c) \( f(x) = x^2 - 3x + 5, \ g(x) = 2x - 3 \)
   (d) \( f(x) = -2x^2 + x - 4, \ g(x) = x^2 + 1 \)
   (e) \( f(x) = x^2 - 4, \ g(x) = \sqrt{x} + 3 \)
   (f) \( f(x) = \frac{2x - 1}{5x + 3}, \ g(x) = \frac{x}{x + 1} \)
   (g) \( f(x) = \sqrt{x - 3}, \ g(x) = 3 - x \)
   (h) \( f(x) = \frac{2x}{x^2 - 4}, \ g(x) = \frac{1}{x} - 2 \)
   (i) \( f(x) = x^2 + 4, \ g(x) = \sqrt{3 - x} \)
   (j) \( f(x) = x, \ g(x) = 2\sin x \)
   (k) \( f(x) = -x, \ g(x) = \sqrt{x} \)
   (l) \( f(x) = 3, \ g(x) = x^2 - 5x + 5 \)
   (m) \( f(x) = x^2 + 3x - 7, \ g(x) = \sqrt{x - 1} + 1 \)
   (n) \( f(x) = \cos 3x, \ g(x) = x^2 - 1 \)
   (o) \( f(x) = \log_2 x, \ g(x) = -\sqrt{x + 3} \)

(7) If \( f(0) = -4 \) and \( g(-4) = 6 \) what is \( (g \circ f)(0) \)?

(8) The graph of the functions \( f \) and \( g \) are shown in Figure 1. Find the following values:
   (a) \( (f \circ g)(0) \)
   (b) \( (f \circ g)(-2) \)
   (c) \( (g \circ f)(1) \)
   (d) \( (g \circ f)(-1) \)
   (e) \( (g \circ f)(-4) \)
Figure 1. Two functions

(9) Let \( l(x) = x + 3 \). For each of the following functions \( f \),
   - find \( f \circ l \), \( l \circ f \)
   - graph \( y = f(x), y = (f \circ l)(x), (l \circ f)(x) \) on the same grid.
   (a) \( f(x) = x^2 \)
   (b) \( f(x) = -x^2 \)
   (c) \( f(x) = x^3 \)
   (d) \( f(x) = |x| \)

(10) Repeat the previous exercise with \( l(x) = x - 2 \)