1. Find the derivative of each of the following functions.

(a) $f(x) = \ln\left|3x^2 - 2\right|$

(b) $f(x) = \dfrac{x}{\ln(x)}$

(c) $f(x) = x\ln(x) - x$

(d) $f(x) = \ln\left|\sec(x) + \tan(x)\right|$

(e) $f(x) = \sqrt{1 + e^{2x}}$

(f) $f(x) = e^x \ln(x) + xe^{3x-1}$

2. Use logarithmic differentiation to find y' for

(a) $y = \ln\left(\dfrac{(3x-2)^3(x+1)}{\sqrt{1-x^2}}\right)$

(b) $y = \dfrac{\sqrt{x^2-36}\,(x^2-x-6)}{x^2+7x+12}$

3. Show that $f(x) = (x-2)^2 + 5$ is not one-to-one.

4. (a) Prove that $g(x) = \dfrac{3x-2}{x+3}$ is one-to-one.

(b) Find the inverse function for g.

5. (From the 200? AP Calculus AB exam) The twice-differentiable function f is defined for all real numbers and satisfies the following conditions:

$$f(0) = 2, f'(0) = -4, \text{ and } f''(0) = 3.$$

The function g is given by $g(x) = e^{ax} + f(x)$ for all real numbers, where a is a constant. Find $g'(0)$ and $g''(0)$ in terms of a. Show the work that leads to your answers.

6. (From the 200? AP Calculus AB exam) A particle moves along the x-axis with position at time t given by $x(t) = e^{-t}\sin(t)$ for $0 \leq t \leq 2\pi$.

   (a) Find the time t at which the particle is farthest to the left. Justify your answer.

   (b) Find the value of the constant A for which $x(t)$ satisfies the equation $Ax''(t) + x'(t) + x(t) = 0$ for $0 < t < 2\pi$.

7. (From the 200? AP Calculus AB exam) Let f be the function defined by $f(x) = k\sqrt{x} - \ln(x)$ for $x > 0$, where k is a positive constant.

   (a) Find $f'(x)$ and $f''(x)$.

   (b) For what value of the constant k does f have a critical point at $x = 1$? For this value of k, determine whether f has a relative minimum, relative maximum, or neither at $x = 1$.

   (c) For a certain value of the constant k, the graph of f has a point of inflection on the x-axis. Find this value of k.