Exercise 1. Show that the following equations have at least a solution in the specified interval. Use a calculator to evaluate the values of the transcendental functions at some specific points.

(a) \( \ln(x) = x - \sqrt{x} \), \((2, 3)\).

(b) \( \sin x = x^2 - x \), \((1, 2)\).

(c) \( \ln(x) = 3 - 2x \), \((1, 2)\).

Exercise 2. (a) Compute the derivative of the function

\[
f : (0, +\infty) \to \mathbb{R}
\]

\[
f(x) = x \sin x.
\]

(Hint: use the formula \( e^{\ln a} = a \).)

(b) More generally, compute the derivative of \( f(x)^{g(x)} \), where the range of \( f \) is contained in \((0, +\infty)\). Write your own Differentiation Rule for the derivative of \( f(x)^{g(x)} \), and give it a name.

(c) Choose three examples of functions of the type \( f(x)^{g(x)} \), and compute their derivative using your own Differentiation Rule.

Exercise 3. For every one of the following functions \( f(x) \), compute the derivative.

(a) \( f(x) = \frac{\tan x}{1 + \cos x} \).

(b) \( f(x) = x \arccos(x) \).

(c) \( f(x) = [\arcsin(2x)]^2 \).

(d) \( f(x) = \ln(\sec x) \).

(e) \( f(x) = \cot(\csc x) \).

(f) \( f(x) = e^{x \sec x} \).

(g) \( f(x) = \sqrt{\sin(\sqrt{x})} \).
**Exercise 4.** For every one of the following functions $f'$, find a function $f$ whose derivative is the given function.

(a) $f'(x) = 3x^2$.
(b) $f'(x) = 4x^3$.
(c) $f'(x) = x^5$.
(d) $f'(x) = -1$.
(e) $f'(x) = x^2 + 3x + 1$.
(f) $f'(x) = \frac{1}{x^2} + \frac{1}{x^3}$.
(g) $f'(x) = \frac{1}{x} + \frac{1}{x^3}$.
(h) $f'(x) = e^x$.
(i) $f'(x) = 2^x$.
(j) $f'(x) = (\tan x)^2$.

**Exercise 5.** Find the absolute maximum and absolute minimum of the given function $f$.

(a) $f : [0, 4] \to \mathbb{R}$, $f(x) = 5 + 54x - 2x^3$.
(b) $f : [-2, 3] \to \mathbb{R}$, $f(x) = (x^2 - 4)^3$.
(c) $f : [0, 3] \to \mathbb{R}$, $f(x) = \frac{x}{x^2 - x + 1}$.