1. Find the \( \lim_{x \to 1^+} \left( \frac{3}{1-x} \right)^{x-1} \).

2. Differentiate the function \( y = (\ln x)^{\tan(2x)} \).

3. Differentiate the function \( y = (\sin x)^{\arcsin x} \).

4. After 500 years, a sample of radium-226 has decayed to 80.4% of its original mass.
   a. Find the half-life of radium-226.
   b. Find an equation for the amount \( A(t) \) of radium-226 left after \( t \) years.

5. Differentiate the functions \( y = \cos^{-1} \left( \frac{x+1}{2x+1} \right) \) and \( y = \tan^{-1}(e^{2x} - \ln x) \).

6. Evaluate \( \lim_{x \to 0^+} \frac{\ln x}{\sqrt{x}} \) and \( \lim_{x \to 0^+} (\sin x)^x \).

7. Find the absolute maximum and minimum values of the function \( f(x) = -\sqrt{5} - x^2 \) in the interval \([ -\sqrt{5}, 1 ]\).

8. For each of the two functions listed below, find intervals where the function is increasing/decreasing, local maximum and minimum points, intervals where the function is concave up/down and inflection points: \( f(x) = e^{1/x} \) and \( f(x) = x^{7/3} + x^{4/3} \).

9. A rectangle is to be inscribed in a semicircle of radius 2. What is the largest area the rectangle can have, and what are its dimensions?

10. Find the value \( h \left( \frac{\pi}{4} \right) \) if \( h'(x) = \sec^2 x + \frac{1}{2\sqrt{x}} \) and \( h(\pi) = 0 \).

11. Determine all the numbers \( c \) which satisfy the conclusions of the Mean Value Theorem for the function \( f(x) = x^3 + 2x^2 - x + 8 \) on \([-1, 2]\).