1. Compute the following derivatives:

(a) \( f(x) = \arctan(x) \Rightarrow f'(x) = \)

(b) \( f(x) = \ln(x) \Rightarrow f'(x) = \)

(c) \( f(x) = \log_3(x) \Rightarrow f'(x) = \)

(d) \( f(x) = \frac{\arctan(\log_3(7x))}{x^4 + 2x} \Rightarrow f'(x) = \)

2. (a) Find the derivative of \( y = \frac{x^2 \sin(2x)(x^5 - 7x)^6}{(\sqrt{x^9 + 1})3^x} \)

(b) Let \( f \) be a continuous function with

- \( f(0) = 3 \)
- \( f(2) = 6 \)
- \( f'(x) = 0 \) for \( 0 < x < 1 \)
- \( f'(x) < 2 \) for \( 1 < x < 2 \)

Sketch such a function or explain why it is impossible.

3. Let \( f(x) = \frac{x^3}{3} - 2x^2 + 3x + 1. \)

(a) Find the intervals where \( f \) is increasing, and the intervals where it is decreasing.

(b) Find the intervals where \( f \) is concave up, and the intervals where it is concave down.

(c) We wish to approximate \( f(0.01312) \). A crude approximation is \( f(0.01312) \approx f(0) = 1. \)

Use a linear approximation to \( f \) based at \( x = 0 \) to give a better estimate for \( f(0.01312) \).

4. The volume of a spherical cell of radius \( r \) is given by

\[ V(r) = \frac{4}{3} \pi r^3. \]

If you can determine the radius within an accuracy of 3%, how accurate is your calculation of the volume?