Problem 1 (20 points). Using the definition of the derivative find that the derivative of $\frac{1}{x}$ is $-\frac{1}{x^2}$.

Problem 2 (20 points). Using the formula $\tan(x) = \frac{\sin(x)}{\cos(x)}$ and formulas for derivatives for \(\sin\) and \(\cos\) find the formula for derivative of \(\tan\).

Using the formula for derivative of \(\tan\) find the derivative of its inverse function \(\tan^{-1}\).

Problem 3 (20 points). Let \(f\), \(g\), and \(h\) be three differentiable functions. Find the formula for the derivative of \((f \circ g \circ h)(x) = f(g(h(x)))\). (Hint: Use the chain rule!)

Problem 4 (20 points). Prove that

$$|\sin(x) - \sin(y)| \leq |x - y|$$

for all \(x, y \in \mathbb{R}\).

Problem 5 (20 points). Find

$$\lim_{x \to 0} \frac{\sin(x) - x}{x^3}.$$