1 (35 pts.) Differentiate the following functions. Show your work if you wish to receive partial credit. You do not need to simplify your answers.

(a) \( f(x) = \frac{3x+7}{\sqrt{x^4+1}}. \)

(b) \( f(x) = \frac{x^2+1}{\tan^{-1}(x^2+1)}. \)

(c) \( f(x) = e^{2x-1}\sqrt{x+1}. \)

(d) \( f(x) = \sec^2(x + \sin x). \)

(e) \( f(x) = (\log_5 x)^{10}. \)
2 (8 pts.) If \( f(x) = 1/x \), find \( f'(2) \) directly from the definition of the derivative.

3 (15 pts.) Suppose \( u(x) \) is a differentiable function of \( x \), and let \( f(x) = x^{u(x)} \), for \( x > 0 \). Using logarithmic differentiation, find \( f'(x) \), in terms of \( x, u(x), \) and \( u'(x) \).
Suppose \( f(x) = x^3 - ax + b \). Find \( a, b \) if \((1, 1)\) is on the graph \( y = f(x) \), and the tangent line to the graph at \((1, 1)\) has slope \(-3\).

Find the equation of the line tangent to the curve defined implicitly by \( 2 \sin^{-1} y = x^2 \) at the point \( (\sqrt{\frac{\pi}{2}}, \sqrt{\frac{1}{2}}) \).
Consider the function

\[ f(x) = \begin{cases} 
  x \sin \frac{1}{x} : & x \neq 0 \\
  0 : & x = 0 
\end{cases} \]

Is \( f(x) \) differentiable at \( x = 0 \)? Why or why not? If so, what is \( f'(0) \)?