

- 1 (40 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) $f(x) = (\ln x)^{10}$.

2 (10 pts.) Suppose $u(x)$ is a differentiable function of x , and let $f(x) = x^{u(x)}$, for $x > 0$. Find $f'(x)$, in terms of $x, u(x)$, and $u'(x)$. Hint: take the natural log of both sides and use implicit differentiation.

3 (20 pts.) Consider the parametric curve $(-\sqrt{t+1}, \sqrt{3t})$.

(a) Find the tangent line to the curve at the point corresponding to $t = 3$.

(b) Find $d^2y/(dx)^2$ at the same point.

- 4 (10 pts.) Find the equation of the line tangent to the curve defined implicitly by $2 \sin^{-1} y = x^2$ at the point $(\sqrt{\frac{\pi}{2}}, \sqrt{\frac{1}{2}})$.

- 5 (20 pts.) Consider the function

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

- (a) Is $f(x)$ continuous at $x = 0$? Why or why not?

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