Name: Key _____ / 25

There are 25 points possible on this quiz. No aids (book, calculator, etc.) are permitted. **Show all work for full credit.**

1. **[15 points]** Find the derivative for each function below. You do not need to simplify. You do need to use parentheses correctly.

   a. $h(x) = 4^x + \log_4(x)$

   $h'(x) = 4^x \ln 4 + \frac{1}{x \ln 4}$

   b. $f(x) = \sin^{-1}(\sqrt{x})$

   $f'(x) = \frac{1}{\sqrt{1-(\sqrt{x})^2}} \cdot \frac{1}{2\sqrt{x}}$

   c. $y = \left(x^{-1} + \tan^{-1}(x)\right)^3$

   $y' = 3\left(x^{-1} + \tan^{-1} x\right)^2 \cdot \left(-x^{-2} + \frac{1}{1+x^2}\right)$

   d. $g(x) = \frac{x^3 \sin x}{e^x}$

   $g'(x) = \frac{(3x^2 \sin x + x^3 \cos x)e^x - x^3 \sin x e^x}{(e^x)^2}$

   e. $y = \ln\left(\frac{7x^{5/3}}{\sec x}\right)$

   $y' = \frac{1}{\frac{7x^{5/3}}{\sec x}} \cdot \frac{\frac{35}{3} x^{2/3} \sec x - 7x^{5/3} \sec x \tan x}{\sec^2 x}$

2. **[5 points]** Use implicit differentiation to find $\frac{dy}{dx}$ for $e^y = x^3y + 7$. Clearly indicate when you take the derivative of both sides of the equation.

$$\frac{d}{dx}[e^y] = \frac{d}{dx}[x^3y + 7]$$

$$e^y \cdot \frac{dy}{dx} = 3x^2y + x^3 \cdot \frac{dy}{dx}$$

$$e^y \cdot \frac{dy}{dx} - x^3 \cdot \frac{dy}{dx} = 3x^2y$$

$$\frac{dy}{dx}(e^y - x^3) = 3x^2y$$

$$\frac{dy}{dx} = \frac{3x^2y}{e^y - x^3}$$

3. **[5 points]** Use logarithmic differentiation to find $\frac{dy}{dx}$ for $y = x^{\cos x}$. Clearly indicate when you take the derivative of both sides of the equation.

$$\ln y = \ln(x^{\cos x})$$

$$\ln y = \cos x \ln x$$

$$\frac{d}{dx}(\ln y) = \frac{d}{dx}(\cos x \ln x)$$

$$\frac{1}{y} \cdot \frac{dy}{dx} = -\sin x \ln x + \cos x \cdot \frac{1}{x}$$

$$\frac{dy}{dx} = y\left(-\sin x \ln x + \frac{\cos x}{x}\right)$$

$$\frac{dy}{dx} = x^{\cos x}\left(-\sin x \ln x + \frac{\cos x}{x}\right)$$