Show work for all answers.

1. **(6 points)** Given that $y \ln x = 3x \sin y$, find $\frac{dy}{dx}$ by implicit differentiation.

2. **(5 points)** Calculate the *second derivative* $\frac{d^2}{dx^2} \arctan x$.

3. **(5 points)** Calculate the derivative $\frac{d}{dt} \arcsin(e^{4t})$.

4. **(4 points)** Rex takes a 60mg dose of Miraclo at noon; as is ordinary for drug metabolism, the drug is depleted at a rate proportional to the amount currently in his body. At 3PM he only has 10mg of Miraclo left in his body. Construct a function $f(t)$ modeling the quantity of Miraclo in Rex's system $t$ hours after noon.

5. **(2 point bonus)** Given an invertable function $f(x)$ and its inverse $g(y)$, if $f(x_0) = y_0$, find and justify an expression for $g'(y_0)$ in terms of $f'(x_0)$.