Name: ________________________________

Please show all work and box the answers.

1. (20 pts.) Without using the rules of differentiation, find the derivatives of the following functions:
   
   (a) \( f(x) = x^2 \)  \( \quad \) (b) \( f(x) = \frac{1}{x} \)

2. (30 pts.) Find the derivatives of the following functions:
   
   (a) \( f(x) = x^3 - 5x^2 + 1 \)  \( \quad \) (b) \( f(x) = x \cos x \)  \( \quad \) (c) \( f(x) = \sin^3 x^2 \)

3. (20 pts.) Find the equation of the tangent line to the graph of \( y = \sqrt{x} \) at \( x = 4 \). Sketch.

4. (20 pts.) Let \( f(x) = \begin{cases} 
-1 & \text{for } x \leq 0 \\
mx + b & \text{for } 0 < x < 1 \\
1 & \text{for } x \geq 1
\end{cases} \)
   
   For which values of \( m \) and \( b \) is \( f(x) \) continuous? Sketch. Is \( f(x) \) differentiable? Explain.

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