To receive credit for your answers you must show all your work, explain your reasoning carefully and clearly and include all steps necessary to completely justify each answer. Any variables you use must be clearly identified in words. Box in your answers when it is possible. Good luck!

Problem 1. Find the derivatives for each of the following functions using the differentiation rules. Do not simplify! but you have to show your work with all the necessary steps to receive credit.

1. \( f(x) = \frac{x^7 + 9}{\cos(3x)} \)

2. \( f(x) = 3(x^7) \)

3. \( f(x) = \ln[\ln(\ln x)] \)

4. \( f(x) = x^{\sqrt{x^2+1}} \)
Problem 2. Find the derivative $y'$ (or $\frac{dy}{dx}$) at the point $(x, y) = (1, 1)$ if:

$$x^3 + xy - 2y^3 = \sin(x - y)$$

Problem 3. The following figure shows the graphs of a function $f$, its derivative $f'$, and its second derivative $f''$. Identify each graph, and explain briefly your choices.
Problem 4. The position of a particle, moving along a straight line, is given by \( s = f(t) = t^3 - 6t^2 + 3 \) for \( 0 \leq t \leq 5 \), where \( t \) is measured in seconds and \( s \) in feet.

1. What is the velocity at time \( t \)?

2. What is the acceleration at time \( t \)?

3. When is the particle moving forward (in the positive direction)?

4. Find the total distance travelled (not the displacement!) during the first 5 seconds.

5. Find the intervals where the particle is speeding up.
Problem 5. The quantity $q$ of certain Athletic Shoes which are sold depends on the selling price $p$ in dollars: that is, $q = f(p)$.

1. Give the meaning (in practical terms) of $f(150) = 14000$.

2. Give the meaning (in practical terms) of $f'(150) = -100$.

3. Give the best possible estimate of $f(155)$.

4. Extra question: Give the units and meaning (in practical terms) of $(f^{-1})'(10,000) = -0.05$. 