1. Given \( x^2 + y^2 = 25 \), find \( y'' \) without solving the original equation for \( y \) in terms of \( x \).

2. Find the tangent line to the kappa curve given by \( x^2(x^2 + y^2) = y^2 \) at the point \( (\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}) \).

3. Sand falls onto a conical pile at a rate of 10 cubic feet per minute. The diameter of the base of the cone is approximately 3 times the altitude. At what rate is the height changing when that height is 15 feet? (The volume of a cone is \( \pi \times (\text{base radius})^2 \times (\text{height}) \).)

4. Find the extrema of \( f(x) = 3x^4 - 4x^2 \) on the interval \([-1, 2]\).

5. Given the function \( f(x) = \frac{1}{x^2 - 2} \), show that for the interval \((2, 6)\) there is no \( c \) such that \( f'(c) = \frac{f(6) - f(2)}{6 - 2} \). Why does this not contradict the Mean Value Theorem?

6. For the following functions, identify the critical points, the relative extrema, and the intervals on which \( f \) is increasing and decreasing: (a) \( f(x) = (x^2 - 4)^{2/3} \); (b) \( \frac{2x}{x^2 + 3} \).

7. Find the points on the curve \( y = 4 - x^2 \) that are closest to the point \((0, 2)\).

8. An open box is made from a square piece of material, 12 inches on a side, by cutting equal squares from each corner and bending the sides up. What is the largest volume of a box constructed in this way?

9. Estimate \( f(3.1) \) where \( f(x) = \frac{x}{x+1} \).

10. If \( x = 3t^2 + 1 \) and \( y = \sin(4\pi t) \) find \( \frac{dy}{dt} \) when \( t = 1 \).

11. Show that the equation \( x^4 + 2x^2 - 2 = 0 \) has exactly one solution on \([0, 1]\).

12. State and prove the Mean Value Theorem. You may use Rolle’s Theorem in your proof.