1) Use the Intermediate Value Theorem to prove that there is a number \( c \) such that \( c^2 = 2 \).

2) Suppose that a function \( f \) is continuous on \([ 0, 1]\) and that \( 0 \leq f(x) \leq 1 \) for every \( x \in [0, 1] \). Show that there must exist a number \( c \in [0, 1] \) such that \( f(c) = c \). (\( c \) is called the fixed point of \( f \)).

3) \( \lim_{x \to 0} \frac{\cos^3 5x - \cos^3 3x}{\sin^2 2x} = ? \)

4) Does the graph of \( g(x) = \begin{cases} x \sin \left( \frac{1}{x} \right) & \text{if } x \neq 0 \\ 0 & \text{if } x = 0 \end{cases} \) have a tangent line at \( x = 0 \)? Explain your answer.

5) Find an equation of the tangent line of the curve \( y = \sqrt{x} \) which is perpendicular to the line \( 2x + 3y = 5 \).

6) A particle moves from right to left along the parabola \( y = \sqrt{-x} \) in such a way that its \( x \)-coordinate (measured in meters) decreases at the rate of 8 m/sec. How fast is the angle of inclination \( \theta \) of the line joining the particle to the origin changing when \( x = -4 \).

\textbf{Hint: Sketch the graph of the given function.}

7) A spherical balloon is inflated with helium at the rate of \( 100 \pi \) ft\(^3\)/min. How fast is the balloon's radius increasing at the instant the radius is 5 ft? How fast is the surface area increasing?

8) Let \( f \) be a differentiable function such that \( f(1) = 1 \) and the slope of the tangent line to the curve \( y = f(x) \cdot f(xy)^2 \) at the point \((1, 1)\) is 3. Find all possible values of \( f'(1) \).

9) Show that if \( u \) is differentiable at 0, then the limit \( \lim_{t \to 0} \frac{u(3t) - u(-2t)}{t} \) exists.

10a) Find \( \frac{dy}{dx} \) for \( y = \left( \frac{2\sqrt{x}}{2\sqrt{x} + 1} \right)^3 \).

10b) Find \( \frac{dy}{dx} \) for \( y = (3 + \cos^3(3x + \sin(2x)))^7 \).