1) Find the volume of the largest right circular cone that can be inscribed in a sphere of radius 3.

2) Show that if $a, b, c$ and $d$ are positive integers, then
\[
\frac{(a^2 + 1)(b^2 + 1)(c^2 + 1)(d^2 + 1)}{abcd} \geq 16.
\]

3) Evaluate $\lim_{x \to -1} \frac{\sqrt[3]{1 + 2x} + 1}{\sqrt{2 + x} + x} = ?$

4) Evaluate $\lim_{x \to 0} \frac{x^2 \sin \left( \frac{1}{x} \right)}{\sin x} = ?$

5) Let $f : [1, 4] \to \mathbb{R}$ be given by $f(x) = \sqrt{x}$. Is there a point $m \in (1, 4)$ such that the tangent line at the point $(m, f(m))$ is parallel to the line passing through the points $(1, 1)$ and $(4, 2)$? If so, find $m$. If not so, explain why not.

6) Find $y'(0)$ where $y(x) = \sqrt{\frac{1 - x^2}{1 + x^2}}$.

7) Find $\frac{dy}{dx}$ where $y(x) = \sin^2(\cos 3x)$.

8) Let $f(x) = g(x + g(x))g(x)$ where $g$ is such that $g(0) = 2, g(1) = 1, g(2) = -5, g'(0) = -3, g'(1) = 7, g'(2) = 4$. Find $f''(0)$. 
