1. (40pts) Differentiate the following functions.
   
   (i) \( f(x) = x^4 + \frac{1}{\sqrt{x}} \)
   (ii) \( g(x) = t^2 \sin t - \tan t \)
   (iii) \( f(x) = \frac{x^2 - 1}{x+1} \)
   (iv) \( h(t) = (1 + t^2)^6 \)
   (v) \( h(x) = \ln(\cos x) + 2^x \)
   (vi) \( f(t) = \frac{\sqrt{1-t^2}}{t} \)
   (vii) \( g(x) = \tan^{-1}(x^3) \)
   (viii) \( h(t) = xe^{\frac{1}{t}} \)

2. (10pts) Using the implicit differentiation, find \( \frac{dy}{dx} \), then use it to find an equation of the tangent line to \( \frac{x^2}{9} + \frac{y^2}{36} = 1 \) at \((-1, 4\sqrt{2})\).

3. (15pts) Find the following limits.
   
   (i) \( \lim_{x \to 0^+} x \ln x \)
   (ii) \( \lim_{h \to 0} \frac{\sin 3h}{\sin 5h} \)
   (iii) \( \lim_{x \to \infty} (1 + \frac{1}{x})^x \)

4. (25pts) Graph \( f(x) = \frac{x^2}{x^2+1} \) by answering the following parts.
   
   (i) Verify that \( f'(x) = \frac{2x}{(x^2+1)^2} \).
   (ii) Classify the regions according to increasing or decreasing of \( f \).
   (iii) Find all the local extrema of \( f \).
   (iv) Verify that \( f''(x) = \frac{2(1-3x^2)}{(x^2+1)^3} \).
   (v) Classify the regions according to the concavities of \( f \).
   (vi) Find the inflection point(s) of \( f \).
   (vii) Find all the asymptotes of \( f \).
   (viii) Graph \( f \).

5. (10pts) Air is being pumped into a spherical balloon at the rate of \( 5\text{in}^3/\text{sec} \). At what rate is the radius of the balloon increasing when the radius \( r \) is 9 inches.