Each problem is worth 10 points.

1. Evaluate the following limits:
   (a) \[ \lim_{t \to 0} \frac{\sqrt{1 + t} - \sqrt{1 - t}}{t} \]
   (b) \[ \lim_{x \to 0^+} (\cos x)^{1/x^2} \]

2. (a) Evaluate the indefinite integral
   \[ \int \frac{\ln(\ln x)}{x \ln x} \, dx. \]
   (b) Use logarithmic differentiation to compute \( f'(x) \), where
   \[ f(x) = \frac{\sqrt{x^3 + 2} \cdot (x - 1)^{2/3}}{(4 + x^2)^3} \]
   for \( x > 1 \).

3. Let \( f(x) = x^5 + 2x \).
   (a) Show that \( f(x) \) is one-to-one on \((-\infty, \infty)\).
   (b) Let \( g(x) = f^{-1}(x) \). Find \( g'(3) \).

4. A continuous annuity with withdrawal rate \( N = 1000 \) \$/year and interest rate \( r \) is funded by an initial deposit of \( P_0 = 10000 \). Let \( P(t) \) be the balance of the account after \( t \) years.
   (a) Write the differential equation satisfied by \( P(t) \).
   (b) What is the smallest value of \( r \) for which the annuity will never run out of money?
   (c) If \( r = 5\% \), at what time will the annuity run out of funds?

5. The number of computers infected by a certain computer virus increases at a rate proportional to the number of computers currently infected. Suppose that on January 20, 2012 there were \( 2^{10} \) computers infected with the virus, and three days later there were \( 2^{12} \) computers infected.
   Let \( P(t) \) be the number of computers infected \( t \) days after the virus was released (i.e. after the first computer was infected).
   (a) What differential equation does \( P(t) \) satisfy?
   (b) Find the formula for \( P(t) \).
   (c) On what day was the virus released?